PAVING AND MUNICIPAL ENGINEERING

A Journal Devoted Specially to Street and Sidewalk Paving, Sewerage, Water-Works Construction, Street Lighting, and all Matters Pertaining to Municipal Engineering.

Published on the 15th of Each Month.

WILLIAM FORTUNE, Editor. - - - WILLIAM C. BOBBS, Business Manager

OFFICE: ROOM 44, CHAMBER OF COMMERCE, - - - INDIANAPOLIS, IND.

Entered at the Post-office, Indianapolis, Ind., as second-class matter.

SUBSCRIPTION: { One Year, ... $1 00. Single Copy, ... 10.

FOREIGN SUBSCRIPTIONS.

Great Britain and Australia...6 s. sterling.	Austria.....4 florins.
France.....8 francs.	Germany.....6 marks.

Advertisements to insure publication should reach the publication office not later than the 5th of the month.

Communications are invited, and all requests for special information on the subjects treated by this journal will receive careful attention.

Articles relating to the different branches of municipal engineering are desired. Stamps should accompany manuscripts for return postage if unavailable.

Vol. III. INDIANAPOLIS, IND., JULY, 1892. No. 2.

CONTENTS.

		PAGE.
Street Paving in New York City	*Stevenson Towle, Consulting Engineer.*	35
Compressive Resistance of Brick	*Prof. Ira O. Baker.*	38
Paving Brick Clays		39
General Traffic Street Tracks		40
Street Sprinkling in Boston and St. Louis		40
Uses of Portland Cement		41
Paved and Dirt Roads Combined		41
Kinds of Pavements in Some American Cities		42
A German Tramway Rail for Protection of Paving (illustrated)		42
A Cheap Kind of Pavement	*S. J. Hathaway.*	42
A New Kind of Curbing		43
Work in Burlington, Iowa		43
Cost of Granite Paving in Detroit	*P. W. Keating.*	43
Personal		43
Patents		43
IMPROVEMENT AND CONTRACTING NEWS—		
Paving		44
Sewerage		45
Water-works		46
Bridges		47
Street Lighting		47

The columns of this publication are open to the discussion of all subjects relating to paving, sewerage, water-works, street-lighting, and the physical improvement of cities. Practical information as to the merits of materials used in such work and new methods, with photographs and drawings, which may be used for illustration, are especially desired. We are glad to get brief notes as to proposed improvements and the letting of large contracts.

City engineers are requested to send us as early as possible copies of their annual reports, which will be given proper notice.

Articles relating to methods of road making and maintenance are invited.

STREET PAVING IN NEW YORK CITY.*

By Stevenson Towle, Consulting Engineer, Department of Public Works.

I HAVE made a general examination of the pavements of the city, and have closely and systematically inspected from time to time the different classes of pavement laid during the past few years to enable me to determine wherein improvements could be effected. These inspections conclusively prove that the new granite block pavements have not only benefited the immediate neighborhoods in which they have been laid, but have added to the general welfare of the city. Merchants, manufacturers and carriers bear testimony to this fact. The advantages derived are particularly noticeable where these new pavements have been laid on streets leading to the great freight depots, wharves and ferries. For years business men have complained of the great tax levied on their business by old and inferior pavements, in waste of labor, loss of time and wear of vehicles. Not only are merchants and the general public benefited by these new pavements, but the owners of abutting property are directly benefited by increased values and rentals. In Europe the advantage of good pavements is fully appreciated, and the best are laid irrespective of cost, which is a secondary consideration. In this city the necessity of good pavements is quite as great as in the cities of Europe. The vast freights brought here by railroads and ships have to be carted and transhipped. To facilitate this traffic well paved streets are indispensable, and have a considerable influence on the profits of business by lessening the time required in transit over streets with inferior pavements. Merchants and shippers recognize this, and are the first to experience the direct benefits of our new pavements. For this reason the rapid extension of new and improved pavements in this city is urged by the Chamber of Commerce which is anxious that our merchants may be enabled to compete on equal terms with those of other cities. Baltimore, Chicago, Cleveland, Cincinnati and Washington are spending large sums of money in improvements to their thoroughfares in order to cheapen and facilitate the handling of merchandise. For this purpose each of those cities has spent several millions of dollars, and the empire city of New York can not afford to be in the rear, but ought to lead the van in such important public works.

On streets subjected to a large amount of heavy traffic, the granite pavements which have been down for a number of years have worn very unevenly, as evidenced by the pavement on Fifth avenue, south of Ninety-second street. This pavement was laid in the very best manner with granite blocks of the standard dimensions. A variation of one inch was allowed in the depth of the block—not less than seven or more than eight inches. The blocks were laid on a two-inch bed of sand to make up for the difference in depth of block, and had the usual foundation of concrete. The unevenness of surface is caused by the difference in the depth of the blocks. The deeper block, as soon as laid, obtains its ultimate bearing on the sand and can sink no further, while the shallow block continues to sink into its deeper bed of sand under heavy traffic, causing an uneven surface. The method of laying the improved stone pavements in London, Liverpool and other European cities differs from ours in that the stone blocks are cut or pitched to a uniform depth, a variation of only one-fourth of an inch being allowed in the depth of the blocks. The blocks are laid on a bed of sand only one-half inch in depth. These blocks are assorted as to size at the government yards and depots by employes of those cities, and are sold to contractors for pavements. This method is very costly, but the extra expense is fully counterbalanced by the better quality and greater durability of the pavements.

These European methods have been considered and their advantages fully recognized; but owing to the additional expense it is not advisable to adopt them. Several large yards would be required which are not to be had in locations that would be suitable; besides, the quarrymen are unwilling to make any change in their methods of getting out and shipping the stone.

Toward the close of the last paving season difficulty was experienced in properly filling the joints of the granite pavement with

* From Report of New York Department of Public Works, 1892.

coal tar and gravel, owing to the rapid rate at which the pavement had to be laid to accommodate traffic and finish the work before winter set in. The specifications for this work are identical with those of London, Liverpool and other European cities. I would not advise any change in the specifications that would lessen the quantity of gravel and increase the quantity of coal tar. The blocks could not be held in place for any length of time by coal tar alone, which naturally softens in hot weather and becomes brittle and easily pulverized in cold weather. The durability of the pavement must depend in a great measure on the gravel filling. The object of the tar filling is to strengthen the pavement by filling the voids in the gravel and holding it in place. I think the quality of the coal tar cement would be greatly improved by the addition of a percentage of asphalt and residuum oil, which would make a more elastic cement, and it would not be so easily affected by changes of temperature.

Careful observations have been made of the asphalts laid during the past three years to ascertain their comparative durability and slipperiness, and what improvements, if any, could be made in the present methods of laying asphalt pavements. Two kinds of asphalt pavements have been laid, the Sicilian rock and the Trinidad, the former two inches and the latter two and one-half inches thick, as required by the specifications. The Sicilian pavement on Madison avenue, between Thirty second and Sixty-sixth streets; Sixty-sixth and Seventy-fifth streets, from Eighth to Ninth avenue; and Forty-eighth street, from Madison to Fifth avenue, was examined and found to be be from one-quarter to one-half inch less in thickness than when first laid. Examinations were also made of the same kind of pavement on Forty-seventh, Sixtieth and Fifty-seventh streets, from Madison to Fifth avenue; Sixteenth street from Avenue A to East river and several other streets. The pavement on these streets was found to be not quite up to the required thickness. This decrease in thickness is due to compression.

Examination of the Trinidad asphalt pavement on all the streets paved therewith showed a depth or thickness exceeding that specified, except on Madison avenue, from Twenty-third to Thirty-second street, and on Chambers street, where the pavement was not quite so thick. It may be stated that the latter two streets were paved before the advent of the present administration.

The Sicilian pavement was found to be thinner in the center of the carriageway than towards the gutters, and, to a lesser extent, the same condition was observed in the Trinidad pavement. In both cases this diminution in thickness is due to the compression caused by the greater amount of traffic on the central portion of the streets. The Sicilian pavement does not attain its ultimate compression until it has been subjected to actual traffic for several months or longer, while the Trinidad pavement attains its final compression as soon as laid. In anticipation of the loss in thickness produced by the greater compression to which the Sicilian rock asphalt is subject, this pavement was laid to an additional thickness of two-fifths of the specified depth before compression. This is not sufficient for the traffic on our streets, and I would recommend that in future this pavement be laid to such a thickness as will give a depth of two and one-half inches when it reaches its ultimate compression.

In noting the comparative slipperiness of the two kinds of asphalt pavements, that of the granite on Fifth avenue was also observed and found, in damp or foggy weather, or when covered with damp street dirt, quite as slippery as the asphalt pavement under the same conditions, and only less slippery by the foothold the sharp toes and calks of horses' shoes obtain in the joints of the stone blocks. I find the Sicilian pavement much more slippery than the Trinidad. This difference is particularly observed on Madison avenue, where there are long sections of the two kinds of pavement. These pavements were laid with the greatest care. The Trinidad has been down four years and the Sicilian one and two years. Both pavements have worn equally well, but the Sicilian has compressed more than the Trinidad. The greater slipperiness of the Sicilian asphalt pavement, as compared with the Trinidad, is due to the difference in the composition of the two pavements. The sharp sand constituting the body of the Trinidad gives a better foothold for horses than the smooth and impalpable limestone forming the body of the Sicilian rock pavement. I know of no way to make the rock asphalt pavement less slippery.

The failure of a portion of the Eighth avenue asphalt pavement, laid in the fall of 1890, was due to the use of asphalt from the village plots of La Brea, on the Island of Trinidad, instead of from the Pitch Lake. The asphalt used in this work was submitted by the contractor and analyzed and approved by chemical experts. Within a few weeks after the pavement had been laid, and before its acceptance, part of it showed indications of disintegration. Examinations were made by this department in conjunction with experts and chemists of the contractor, and resulted in this department requiring the contractor to take up and relay all the defective parts. This was partly done during the past summer, and will have to be completed before the work is finally accepted. The comparative failure of this pavement was exceptional, and, as chemists and experts were unable to account for it, it was decided to lay no more pavement of this character until the cause of the comparative failure was determined. Investigation led to the belief that inferior asphalt had been used in this work, and to satisfy yourself on this point you directed me to continue the investigation, and to personally examine the different deposits of asphalt on the Island of Trinidad as soon as the season would allow. In compliance with your instructions of October 26, 1891, I proceeded to the Island of Trinidad and made a careful inspection of the several mines that have furnished asphalt used in the pavements of this city.

Asphalt is found in different parts of Trinidad, but only in the district of La Brea (Spanish for "The Pitch") is it found in sufficient quantity for commerce, or of a quality suitable for street pavements. The wonderful Pitch Lake is situated there, and also with the extensive deposits of "iron pitch" and "land pitch" on the slope between the lake and the Gulf of Paria.

The lake is about one mile from the sea, at an elevation of 138 feet, and contains 115 acres. It is quite circular in shape, and the outlines are well defined. On the south the land rises gradually from the lake, and on the three other sides the land slopes uniformly from the lake to the sea.

The surface of the lake is not level. It has an inclination of a few inches in one direction, sufficient to drain off the frequent rain-falls. Besides this slight inclination, the surface has a fall of a few inches from the center toward all sides. Another and distinct characteristic is that the surface is not flat and even, but is formed of irregular, oval-shaped flattened domes, or slightly convex surfaces, separated by channels of water a few feet wide and a few inches deep, flowing toward outlets. There are several small islands from 50 to 60 feet in diameter, scattered over the surface of the lake and resting on the asphalt itself. These islands have sufficient depth of soil to support the growth of quite large trees. The whole appearance of the lake is very odd, strange, and difficult to describe. In color it is a dark, chocolate brown, and looks very like a patch of mushrooms flattened out and pressed closely together, separated only by the narrow and shallow channels of water already described. In the center of the lake is a space of several hundred square feet of soft, fluid asphalt. This is the celebrated "Pitch," or "Boiling Spring." Here the temperature is colder than in the solid parts of the lake. The appearance of boiling is due to the escape of large volumes of sulphureted hydrogen gas, which keeps the liquid mass violently agitated. This "spring" is commonly, but erroneously, thought to be the source of supply. In fact, it is the last of the asphaltic deposits, and is ages more recent than the deposits of "iron" and "land pitch," and much more recent than the solid part of the lake itself. This very fact should prove conclusively that the lake has never overflowed to form the deposits outside it, and that these deposits of "iron" and "land pitch" had no such origin.

The surface of the lake is sufficiently firm to support the weight of loaded carts. The asphalt is mined for commerce from different parts of the lake to a convenient depth of about three feet. It

is easily excavated with picks, loaded directly into carts and hauled to the shore ready for shipment. A marked peculiarity of the Pitch Lake is, that the pits or excavations made during the day fill up during the night, and in a few days no trace of them can be found. This is due to the great viscosity of the lake asphalt, and is one of the features which distinguishes it from all other asphalts found in this district. On the slopes from the lakes to the sea, and beneath the sea itself, are found the vast deposits known as "iron" and "land pitch." The greater part of these are covered with several feet of earth, supporting a dense tropical forest growth. The village of La Brea is over these deposits, the houses and streets resting directly on the pitch itself. These deposits are known by American dealers as "overflow pitch," but the inhabitants and geologists term them "iron" and "land pitch." The asphalt from these deposits varies in color from gray to black. The "iron pitch" exists in extensive compact masses or detached deposits and is extremely hard and brittle, and almost black in color. The "land pitch" is found mixed with more or less dirt and foreign matter, and varies in color from gray to black. Both kinds are mined from the village lots and from deposits on both sides of the road leading from the village to the lake. These village plots are the ordinary size village lots and are generally occupied by the cabins of the owners, who either mine the deposits themselves or lease them to others for mining. The asphalt is carted to the shore and piled in heaps ready for shipment, which is almost exclusively to the United States, as the accompanying table of exports will show. The carges are often made up of asphalt mined from several different deposits. This accounts for the great variety met with in the same shipment. I noticed one pile made up in this way, and adjoining it a pile of "lake" asphalt. The difference in the two was very marked. The pile of "land" and "iron pitch" was of a variety of colors, from gray to black, lusterless and brittle, and mixed with earth and decomposed asphalt. This latter feature was owing no doubt to careless sorting and "cutlassing," as the cutting and trimming off the decomposed surfaces of the deposit is called. The pile of asphalt from the lake was bright and uniform in color. Another peculiarity of the "iron" and "land pitch" is that when excavations are made the walls of the remaining asphalt do not run in and fill up the excavation. The angles and projections only are rounded off and softened by the sun's heat. This shows that these kinds flow but slowly, if at all, and in this respect are very different from the lake deposit.

The different asphalts found on the Island of Trinidad have, undoubtedly, a common origin. Geologists, however, differ on this point. Messrs. Wall and Sawkins, government geologists, hold that the asphalts are of vegetable origin, and formed in the same way as peat and coal. In this opinion most geologists agree. Others claim that the asphalts are of volcanic origin, and some hold that the source is to be found on the mainland of South America opposite, where there are found vast deposits.

The government geologists, in their report of 1860, page 139, describe the asphalt found on the Island of Trinidad as three kinds: "'Glance,' which is rare and very brittle, and but little used; 'asphaltic oil,' found in very small quantities and of poor quality, 'asphalt proper,' containing from 20 to 35 per cent. of earthy matter, preserving its elasticity, which, however, gradually disappears on long exposure to sun and atmosphere. This is a very essential characteristic to which many phenomena exhibited are attributed."

On page 142 of the same report, the geologists say: "La Brea point is lined with masses of asphalt, derived from blocks and fragments of bituminous strata scattered about. The surfaces of these masses consist of brown, porous, sandy earth, which occurs extensively about La Brea, and is evidently the mixed residue of the substance. This shows that there is not only a removal of the volatile constituents, but also an expulsion and perhaps oxidation of the fixed carbon. These remarks refer to the bituminous material scattered over the La Brea district, and especially to that between the village and the lake, from streams that have issued at some former epoch."

On page 143, the geologists explain the peculiar wave or furrow appearance on the road between the lake and the village. "This ridging and furrowing are not evidence of flowing, but are due to constant expansion and contraction (due to the difference of temperature, which is often as great as 100 degrees in a day) and to the effects of traffic." This, some parties choose to believe, is evidence of the lake overflowing.

I shall leave the question of the origin of the asphalts for the geologists to decide, and confine my investigation solely with a view to determining the properties and characteristics of the different kinds of asphalt and which will make the most durable pavement.

I collected and brought home with me samples of asphalt from different mines in the La Brea district, which are fair samples of the different deposits. These I submitted to Messrs. Ricketts and Banks, chemists, School of Mines, Columbia College, for analyses. The samples were submitted by numbers only. The following report shows the nature of the asphalts:

NEW YORK, January 2, 1892.

Thomas F. Gilroy, Esq., Commissioner of Public Works, No. 31 Chambers street, New York:

DEAR SIR—We have completed our test of the nine samples of asphalt submitted to us by Consulting Engineer, Mr. Stevenson Towle, with instructions to report to you, and we have now to report as follows:

Mark on Sample.	Matter Extracted, Carbon Bisulphide (Bitumen)	Character of the Mineral Matter	Melting Point.	Oils at 400° F.
No. 6,085—No. 5...	48.89 per ct.	Consists chiefly of silica, alumina, oxide of iron and lime	245° F.	1.88 per ct.
No. 6,086—No. 6...	49.63 per ct.	Consists chiefly of silica, alumina, oxide of iron and lime	165° F.	1.32 per ct.
No. 6,087—No. 7a..	52.10 per ct.	Consists chiefly of silica, alumina, oxide of iron and lime	160° F.	3.55 per ct.
No. 6,087—No. 7b..	50.12 per ct.	Consists chiefly of silica, alumina, oxide of iron and lime	160° F.	2.91 per ct.
No. 6,087—No. 7c..	49.73 per ct.	Consists chiefly of silica, alumina, oxide of iron and lime	160° F.	2.27 per ct.
No. 6,087—No. 7d..	53.77 per ct	Consists chiefly of silica alumina, oxide of iron and lime	160° F.	4.16 per ct.
No. 6,088—No. 8...	48.27 per ct.	Consists chiefly of silica, alumina, oxide of iron and lime	170° F.	1.72 per ct.
No. 6,089—No. 9...	46.32 per ct.	Consists chiefly of silica, alumina, oxide of iron and lime	250° F.	2.29 per ct.
No. 6,090—No. 10..	45.08 per ct	Consists chiefly of silica, alumina, oxide of iron and lime	185° F.	0.48 per ct.

As the percentage of moisture in the sample is constantly varying, we have made all of the above determinations on the dry samples. Very truly yours,

(Signed) RICKETTS AND BANKS.

P. S.—Samples No. 6,087 (No. 7*a*, No. 7*b*, No. 7*c*, No. 7*d*), No. 6,088 (No. 8), No. 6,089 (No. 9), and 6,090 (No. 10), were also marked "Trinidad asphalt."

Sample No. 5 is from Hadley's heap, and from excavation adjoining village lot No. 76.

Sample No. 6 is from Da Sanlos mine.

Samples Nos. 7*a*, 7*b*, 7*c*, and 7*d* are from different parts of the Pitch Lake.

Sample No. 8 is from Ferras' heap, village lot No. 22.

Sample No. 9 is from Roman Catholic Church lot.

Sample No. 10 is from Hadley's mine, Crown lands.

It will be seen from the report that there is a difference of 3.80 per cent. in the bitumen contained in the respective samples. A marked difference in the softening points will also be observed, the variation being as great as 90 degrees F. In asphaltic oil there is a difference of 3.68 per cent. These differences in favor of the Lake asphalt, which contains a much larger quantity of bitumen and asphaltic oil than the samples of the other deposits, and will require the addition of less residuum oil in the preparation of the asphaltic cement for street pavements.

In my judgment asphalt showing a deficiency of asphaltic oil is not suitable for pavements, as deficiency in that oil detracts from the durability of the pavement.

The analyses also show that the asphalts containing the least

asphaltic oil have the highest softening point, and are consequently harder and more brittle than asphalts with a lower softening point, and correspondingly greater elasticity, which latter quality paving experts consider essential, as it gives the pavement the necessary adhesiveness.

Trinidad asphalt is extensively used in Europe in the pavement of sidewalks, and a condition in the specifications for such work is that the asphalt shall be "viscuous and not brittle under ordinary temperatures."

The following table furnished by Mr. John Fanning, collector of customs, Port of Spain, shows the quantities of asphalt exported from Trinidad:

Statement Prepared by John Fanning, Collector of Customs, Showing Quantity of Pitch Exported from the Island of Trinidad during 1888, 1889, 1890 *and to September* 30, 1891.

Year	From Pitch Lake.				From Land Other Than Pitch Lake.			
	To United States		To Other Countries.		To United States.		To Other Countries	
	Raw Tons.	Refin'd Tons.	Raw Tons.	Refin'd Tons.	Raw Tons.	Refined Tons.	Raw Tons.	Refined Tons.
1888	24,480	8	8,290	9,308	$5,020\frac{287}{1000}$	1,905	$600\frac{3}{6}$	$1\frac{810}{1000}$
1889	46,690	504	10,186	8,932	9,247	2,042	.....	.....
1890	38,520	.....	13,221	9,760	16,460	880	$\frac{4}{6}$	.....
1891	45,170	.....	8,466	$8,394\frac{1}{2}$	$10,450\frac{1}{3}$	.....	127	.....

It will be seen from the foregoing table that nearly the whole quantity of asphalt exported to Europe was from the Pitch Lake, viz.:

From the lake..... 40,163 tons raw.
" ..... 36,394 tons refined.

Total..... 76,557 tons.

From outside the lake..... 728.0 tons raw.
" ..... 1.8 tons refined.

Total ..... 729.8 tons.

This large proportion of lake asphalt exported to Europe would indicate that the lake asphalt alone meets the requirements of foreign specifications.

The table also shows that 41,177 tons of raw and 4,827 tons of refined asphalt, taken from lands outside the lake, were imported into the United States, the greater part having been used in pavements. * * *

The asphalt mined from the Pitch Lake is a merchantable commodity, and can be easily purchased by those desiring to do so and willing to pay the price. The additional export duty on lake asphalt is only 40 cents per ton, the full duty being $1.60, and on asphalt from lands other than the lake, $1.20.

The durability of asphalt pavements depends wholly on the suitability of the asphalt for the purpose. It must be of such a nature as to permanently and thoroughly cement together the sand and limestone powder forming the body of the pavement. It must be elastic, independent of the residuum oil required in making the paving cement, and in no degree brittle.

To secure materials that may be relied on to make the best pavements, it is the practice of European engineers to designate in the specifications not only the kind of asphalt to be used, but also to name the mines and companies that will be allowed to furnish the material, and only to receive bids from such contractors as have shown ability to furnish the material required, and have done satisfactory work.

It has been found necessary to follow this practice in this city as to material for rock asphalt pavement, and the same course should be followed with regard to the Trinidad asphalt pavements.

In view of the importance of obtaining the best asphalt, I would recommend that the asphalt from the Pitch Lake at La Brea, Trinidad, be made the standard of quality. This standard is now required by the specifications for asphalt pavements in Washington.

Numerous applications have been received from parties interested in special kinds of pavements for permission to lay samples on trial. These applications have been denied on account of the trouble, expense and inconvenience such tests have involved heretofore. To be of practical value these tests must be made on a large scale, and the introducers of new pavements are reluctant to lay sufficiently large areas for the purpose of thorough tests. When such experiments are at an end the city generally has to bear the expense of removing the new and restoring the old pavement.

Among the applicants for new pavements there are many who favor wood. These are persons who have seen the wooden pavements of Europe and returned home impressed with the idea that this kind of pavement is the only suitable one for such a thoroughfare as Fifth avenue and other similar avenues. Wooden pavements are a very expensive luxury. Their success in Europe is due not only to their expensive construction and careful and costly maintenance, but also to favorable conditions there which do not exist in this country. There the width of tires and wheels and the manner of shoeing horses are regulated by law, smooth, shoes, without calks or toes and wide tires to wheels only are allowed. The narrow tires of wheels and the sharp toes and calks of horses' shoes in this country are very destructive to pavements, particularly those constructed with wood.

The people of this city would be unwilling to pay for the luxury of wooden pavements the price London and Paris pays. The maintenance of these pavements alone costs fully thirty-six cents per square yard per year. Paris has recently made large contracts for laying wooden pavements and pays for laying and maintenance for a period of seventeen years nearly eighty cents per square yard per year.

Berlin has discontinued the laying of wooden pavements for the reason that they are the most slippery in frosty weather, and not on account of their expense.

Brick pavements are now extensively laid in many western cities and their use in this city is very strongly urged by their advocates, who argue that their long use in Holland is a sufficient guarantee of their durability.

There is no doubt as to the long life of brick, and that brick pavements have the advantage of being less noisy than stone and more economical. But the use of brick pavements has been limited to streets subject only to the light travel of former times, and they are not strong enough to withstand the heavy traffic of the present day.

It is claimed that, by a new process of manufacture, a superior brick, equal to stone, is made for paving. This may be true, but I can not advise the laying of this pavement except as an experiment and at the expense of the parties desiring to introduce it.

The asphalt block pavement laid a year ago on Eighty-seventh street is in good order but until a sufficient time has elapsed to test its durability, I can not advise that any more of it be laid.

THE COMPRESSIVE RESISTANCE OF BRICK.

By Ira O. Baker, Professor of Civil Engineering, University of Illinois.

IN testing some paving brick, the writer made some preliminary experiments by preparing the surfaces in five ways, viz.: 1. Grinding as nearly flat as possible upon the convex side of an emery stone, and crushing between self-adjusting, parallel, cast-iron plates. 2. Removing the irregularities of the surface by grinding, and crushing between blotting paper. 3. Removing the irregularities of the surface, and crushing between the straw board. 4. Removing the irregularities of the surface, coating with plaster of Paris and placing under slight pressure until set (12 to 24 hours), and then crushing; and 5, coating with plaster of Paris, which was afterwards ground down on a sand-paper disk, to the surface of the brick so as so leave a minimum thickness with a perfectly flat surface, and then crushing.

After a considerable number of experiments, it was decided that there was no great difference between the first three methods, while the difficulties in applying the last two were so great as to render them worthless. With a grade of brick which was quite uniform in quality, the first three methods gave 7,000 to 9,000 pounds per square inch as the crushing strength of cubes. The fairly close agreement of the results was considered satisfactory evidence that the method employed secured the full strength of the brick. Subsequently the writer decided to determine the strength of cubes when the pressed surfaces were prepared with the greatest care. The samples were prepared on a rubbing bed at a marble dressing establishment, by the ordinary workmen, with instructions to secure perfectly flat surfaces. The brick were of the same grade as those referred to above, and many of the samples were the second halves of the brick used in the first experiments. The strength of the carefully prepared cubes ranged from 16,000 to 21,000 pounds per square inch, and averaged a trifle over 18,000.

The conclusion derived from the two series of experiments is that an almost imperceptible difference in the flatness of the test specimens makes a very great difference in the strength. Obviously this difference is greater the harder and more brittle the brick or stone. It is perhaps well to repeat that tests of compressive resistance of blocks of stone or brick are useful only in comparing different samples, and give no idea of the strength of masonry constructed of these materials.

It is interesting to notice that Rankine and Trautwine, standard British and American authorities, in editions of their engineers' manuals published a few years ago, give the crushing strength of the best brick at 1,100 and 4,000 pounds per square inch, respectively; while there has recently been tested in the University testing laboratory three lots of brick which averaged from 15,000 to 18,500 pounds per square inch. The difference is probably due mainly to improvements in the manufacture of brick. The crushing strength of granite, when tested under similar conditions, is from 12,000 to 20,000.—*Technograph.*

PAVING-BRICK CLAYS.

ON the subject of clays suitable for the manufacture of paving brick, a writer in the *Clay-Worker* says: "Various opinions have been expressed and much free advice given upon the subject of the selection of proper clays for the manufacture of paving brick. Some of the statements made both in the discussions at conventions and in articles published in periodicals devoted to the clay-working interests have the appearance or at least suggest that individual interests are being advanced.

"Many clay-workers of to-day in the western states have vivid recollections of the effort made ten or twelve years ago by a few manufacturers of drain tile to establish the idea that good tile could not be made of common clays, but that the proper thing was to use fire-clay tile. These manufacturers were working a clay that did not burn red, and they hoped to prejudice the public mind against red tile.

"They soon found that they had shouldered more than they could carry, as excellent tile were being made of common clays that burned red. The manufacturers of red tile retaliated by showing that fire-clay was not at all adapted to the manufacture of drain tile. Because of its essential characteristics it contained no fusible ingredients, and hence would not assume, under the heat of the kiln, the conditions necessary to the successful resistance of the disintegrating influences of moisture and frost.

"The advocates of fire-clay changed their tactics and advocated potter's clay tile, but by this time the red tile had been given a fair trial and had been received into the good graces of the farmers.

"The paving brick interests are passing through a similar experience, with the difference that in some localities the paving brick made of common clays were first used, and grandly stood the test for years, notably at Bloomington, Illinois, and these same brick demonstrated to the satisfaction of all concerned that pavements made of brick were to be the pavements of the future.

"The effort has been made by manufacturers in a few localities to disseminate the idea that paving brick should be made after their kind, or made of clays such as they are working, and that their kind of brick are superior to all others.

"Custom has made this practice admissible as an advertising scheme, and maybe their brick are superior, but the stern fact stands prominently before the minds of those who have taken the pains to investigate the matter that good and acceptable paving brick are being made from a great variety of clays. These clays are so very different that no one can consistently say that this or that kind should be used to the exclusion of those that differ materially from it in color or mechanical condition. Another stern fact which relates to the color of clays used is, that some manufacturers are successfully using yellow, others red, blue, gray, white and light steel gray.

"A third stern fact is, that clays differing widely in their mechanical condition are being utilized in the manufacture of good paving brick.

"At Moberly, Mo., they work a clay that is almost as hard as stone and which must be blasted from the bank. At Decatur, Ill., the clay used is a common yellow joint clay, and is spaded directly from the bank. At Des Moines, Ia., a layer of soapstone is mixed and ground up with the clay. In Galesburg, Ill., a shale or marl is used. Some of the clays are found on the surface of the earth, while others are mined a hundred feet deep.

"These facts lead inevitably to the conclusion that the seeker for a clay from which to manufacture paving brick need accept or reject none because of their color, mechanical condition, or position with reference to the surface of the earth.

"An eminent authority, who has had a wide knowledge of clays in many states of the Union, and who has made a special study of brick pavements and paving brick—Mr. J. J. W. Billingsley, the editor of the *Drainage Journal*—expressed his opinion upon this subject as follows: 'I am confident that clays suited to the manufacture of paving brick are not the exception. I believe that common clays could be manufactured into pavers with proper management.'

"In the preparation of the various clays in use, the methods employed by different manufacturers are as varied as the clays to be prepared.

"One clay is pit-soaked one day, passed through smooth roll crushers and then carried by an elevator directly to the brick machine. Another will not take water until it has been exposed to the air for some time. A third is passed through rollers where it is ground fine, then screened and pugged. A fourth is ground in a dry pan, screened, pugged through two mills and then pugged and molded by stiff clay machine, and the brick are then repressed.

"Thus we learn that some clays will make good paving brick with comparatively simple processes of manufacture, while others pass through more elaborate and expensive modes of treatment.

"The fact stated above that the clay must contain some ingredients that will resist the action of the heat in the kilns, and by so doing preserve the form of the brick, and others that will fuse and unite all particles into a dense, solid, and, as nearly as possible, an impervious mass, suggests the advisability, in some cases, of mixing different clays and thus obtaining the necessary combination of fusible and non-fusible ingredients. Here, also, may be found a reason why fire-clays and a great many beds of nearly pure or simple clays will not make good paving brick, and why so many beds of so-called common clays, which are always of a complex composition, are so admirably adapted to this use. It is not only necessary that the clay that enters into the composition of a paving brick should contain the two classes of materials just named, but it is very essential that these should be finely divided and thoroughly mixed.

"Two of the essentials of a good paving brick are that it shall be homogeneous and impervious to water. These conditions can only obtain from a mixture of different clays by thoroughly incorporating the ingredients so that each constituent particle of clay in the brick may contain a proper share of the elements that

resist heat and thus tend to preserve the form, and those that melt and unite the particles together into a homogeneous and impervious whole.

"This condition can only be obtained from a mixture of various clays by a thorough process of grinding and pugging. These operations not only reduce the clays to a finely divided condition but thoroughly and uniformly mingle the finely comminuted particles, and thus place them in the condition necessary for the amalgamation that is to occur through the mechanical and chemical changes that are brought about by the heat in the kiln. Too much stress can not be placed upon the necessity of thorough preparation of the clay.

"Those manufacturers who are making good and satisfactory paving brick with little labor in grinding and pugging are fortunate in possessing a clay in which the work of finely dividing and uniformly associating the ingredients has been done by nature during the process of arranging and depositing their particular beds of clay.

"Unfortunately all are not so favorably situated, and success can only be attained by faithful attention to this work where nature has left it undone.

"In the decision of the methods to be employed and the selection of the proper machines and appliances for the work, the judgment of the manager must be exercised and, in many cases, his success or failure will depend upon the wisdom of his decisions.

"While it is very essential that the clay should be well prepared, 'enough is as good as a feast' in this as in every thing else, and all that is required is that enough work be put upon the clay to make a brick that is good enough. After this has been done any work becomes a useless expense and a source of loss to the proprietor."

GENERAL TRAFFIC STREET TRACKS.

A well meaning but evidently not well-informed editor of the Pittsburgh *Dispatch*, advocated in that paper the construction in his city of what he terms "Universal Street Track;" prefacing his endorsement of the plan by pointing to the fact that heavy teaming seeks the smooth rails of the surface roads in preference to the less yielding and uneven surface presented by stone paving. He advocates the construction of a double track on all the leading streets of the city, which are forty or more feet wide.

He further recommends the construction under an assessment of $1.50 per front foot and holds out the delusive idea that railway companies will readily rent the same, from the city, at juicy rates, and a grand procession will march in endless lines up and down the throughfares.

In the first place, a double track can not be laid with the requisite weight of rail for the purpose named, on the assessment stated, and few property owners would voluntarily invite heavy teaming in front of their premises. As to securing railways as tenants, it is doubtful if in these days they would care to accept the tracks under such conditions, if tendered free. Teamsters who move their loads at barely a walk would naturally insist on holding possession of the rails and refuse to pull out for the cars. This would reduce the speed of the cars to such an extent that few persons could afford the time to ride in them, preferring the much quicker alternative of walking. Under such conditions a car would not be able to earn wheel grease. As already stated in these columns, in many cities the wear to tracks is found to be fully seventy-five per cent. due to wagon traffic which turning in and out, wrenches the track and destroys the guage.

The sensible solution of the street traffic question is in the passing of municipal laws which will fix the width of tire used on teaming wagons on a sliding scale, proportioned to the load desired to be carried, and under which conditions a driver would not be allowed to haul a load in excess of the weight permitted to the width of tires on his wagon; and on a smooth pavement such as asphalt. This plan is already in force in all European cities where, in fact, no vehicles are found with so narrow tires as used on carriges in this country; while the tires on traffic vehicle will be found full twice that in use here for the same weight of load. This is eminently fair and just, and even on the pavement in use here today would effect an annual saving of hundreds of thousands of dollars in all our cities. In the business streets of Chicago the best stone block pavement becomes almost unfit for use in four to five years. A pair of tracks in the center of the street would, however, render no improvement, for they would last a much less time, and require constant inspection and repair.

With wide tires, a smooth payment becomes a possibility, as has been abundantly proved in Buffalo, where a change from a terrible condition of the rockiest cobble-stone, to the present elegant and perfectly smooth street surface makes the streets of that city one of its greatest attractions and chief wonders.

Street railway managers should interest themselves in the character of the paving to be adopted on the streets occupied by their lines, and use every effort to secure a street surface which will not make it at least necessary for teams to travel on the rails. In many western cities paving brick is being used with excellent results, and in such places drivers seem to have little desire to haul on the iron.

Under these conditions it would be folly to track a street for teaming purposes, and we have no hesitation in saying it would never be tried more than once in the same city.—*Street Railway Review.*

STREET SPRINKLING IN BOSTON AND ST. LOUIS.

THE superintendent of the streets of Boston estimates that it will cost $250,000 to sprinkle, eight months in the year, the 434 miles of streets in that city. In this calculation it is estimated that 47½ per cent. of the streets are 40 feet wide or less; that 47½ per cent. are more than 40 feet and less than 66 feet wide, and that 5 per cent. are more than 66 feet wide. He thinks that 66 miles will not need sprinkling on account of isolation, shade and other considerations. His plan is to have a single spread on 140 miles, a double spread on 206 miles, and three or more spreads on twenty-two miles. He estimates that 65 carts will provide for the streets requiring a single spread; 130 carts for those requiring a double spread, and 25 carts for three spreads. These 220 carts at $1,050 each year, will cost $231,000; supervision and assessment will cost $12,000, and water $7,000.

The superintendent refers to the system in St. Louis as one of the best on the local assessment plan under municipal control, water being furnished for this purpose free of expense and each abutter paying a fixed rate per front foot of estate. Of the total length of 422 miles of streets and alleys, 364 miles are sprinkled for a period of 8½ months. The city is divided into forty-three sprinkling districts of from seven to nine miles each, and the work is let out by contracts. The average length of each district is a little over eight miles. The average amount paid for each district is $3,224.

"The street-sprinkling superintendent has charge of the work at a salary of $2,500 per annum, and is assisted by sixteen inspectors at a salary of $1,000 per annum each, with $20 per month allowance for a horse and buggy.

The total amount of the contracts for 1890	$138,621 20
The average cost per mile for the season	336 93
The average cost per front foot	0353
The city recovered by assessment	122,546 62

"The paved streets are sprinkled four times daily, and the unimproved and macadamized streets three times daily, Sundays included.

"The rate of special tax per front foot for sprinkling has been decreasing each year, it having been as high as $.0589 in 1888 and $.0482 in 1889, while for 1890 it is only $.0353. This reduction may be attributed to more careful superintendence and systematic laying out of work.

"The assessment plan involves a large amount of clerical work, covering a space of about three months, during which time it is

found necessary to employ temporary clerks, involving an expenditure of about $2,500, whose duty it is to make the computations and to issue about 61,000 assessment bills.

"All expense of administration is paid by the city, but the actual amount of each sprinkling contract is assessed on the abutting property in proportion that its linear feet front bears to the total linear feet of assessable frontage of the whole district in which the contract is made. The rates in the different sprinkling districts only varied in 1889 from $0.0371 to $0.0630 per linear foot, averaging $0.0482.

"Paved streets are sprinkled twice a day during the months of March, April and November, and three times a day during the months of May and October, and four times a day during June, July, August and September.

"The unpaved streets are sprinkled twice a day during March, April, May, October and November, and three times a day during June, July, August and September.

"One sprinkling only is required on Sunday, except Lindell avenue, the principal driveway to the park.

"The street commissioner determines whether rain has obviated the necessity of sprinkling, also whether the contractor has given the requisite number of sprinklings and the proper quantity of water, and he can change and regulate the time, if found necessary.

"The work in St. Louis has proved more satisfactory and more economical year by year as the system has been perfected."

USES OF PORTLAND CEMENT.

"HOW to Use Portland Cement," is the title of a little pamphlet, neatly printed and of convenient size, which has just been issued for free circulation by the Buckeye Portland Cement Company, of Bellefontaine, O. It gives a vast amount of information on the various phases of the subject, all of practical value to contractors and others who must use cements. Regarding the materials to be used, and the mixing and laying of cements, the following information is given:

"Clean, coarse, sharp sand is best. Slate or other weak friable particles, or those which have the grain coated with scale or humus are bad. Very fine sand weakens the work greatly, and if it must be used, it should be mixed with coarse sand or a much larger proportion of cement. If a handful of sand dropped into a tumbler of water muddies the water very much, the sand should be washed. The more angular and rough the better. The gravel should have the same qualities as the sand, except that it should be between ¼ and 2 inches in size. Avoid porous material. Crushed stone should be freed from the dust. The sand and gravel, or broken stone, form the body of the work, and too great care can not be exercised in choosing them.

"A large board platform should be provided on level ground as near the place of deposit as possible to get the gravel, sand and water conveniently. Spread a measured quantity of cement over a measured quantity of sand on the platform. Turn them with shovels, while dry, four times, or until thoroughly mixed. Then add sufficient water by a sprinkler and turn the mixture again carefully four times. The quantity of water added should be sufficient to thoroughly dampen the mass, so that it will hold its form when pressed in the hand, and when well pounded will have a slight amount of water come to the surface. The gravel, meantime, should have been spread on one side, if there is room; if not, then spread on the sand and cement, it having previously, on the barrows or elsewhere, been wet and the excess of water drained off. Turn all together four times. Don't add too much water. It weakens the concrete. This is a common fault. In dry, hot weather more water is needed.

"Ram the mixture, while fresh, to place, but don't break the stone. Make the layers six to eight inches thick, and of even moisture and density, and the surfaces level and rough, to insure good bond with the next layer above. Wet all walls with which it has contact. Concrete is spoiled if frozen and thawed while setting, and injured if frozen and not thawed before becoming set. To keep mixtures made during freezing weather from injury, use one ounce of salt for every degree of temperature less than 30° F. to a mixture of eighteen gallons of water and one pound of salt. Avoid placing soft concrete in a pumped or moving body of water, as the water will wash the fine cement from the sand and gravel."

Advice as to making cement walks is given as follows:

"Excavate below grade line to the depth of 12 to 16 inches. It is useless to make the excavation deeper than the outlet. The object of the gravel or cinder filling is to make a dry porous foundation for the cement slab. If excavation is made below the outlet it will hold water. Abundant outlet for the water at the lowest point of the filling is necessary. Frequently, the gutter is the only outlet; if so, the excavation should not extend below the level of the gutter. Sandy soils, or those porous at all times, need not be excavated. Stake strips, 2 by 4 inches, solidly on the outside, to keep the walk straight, being careful that the level and fall are right. Fill excavation to within 4 or 5 inches of the top of strips with coarse gravel, stone or cinders, after which tamp and wet well. Then fill to level of tops of strips with concrete made of gravel or broken stone 4 parts; clean, coarse sand 2 parts, and Portland cement 1 part, thoroughly mixed, dry and wet, as described in chapter on the making of concrete, and ram until the water comes to the surface. Blocks of from 20 to 30 square feet must be separated by tar paper or cut effectually. If the concrete is 5 inches thick at the center, the blocks can contain 30 to 40 square feet, and if 6 inches thick at the center, they may contain 60 to 70 square feet. It is better to make all blocks 3, 4 or 5 feet square. Avoid long blocks. Avoid broken joints. Relevel the strips which have become displaced. Notch each end of a straight edge one inch, and strike off the top of the concrete so as to leave one inch space below the level of the top of the strips for the top cement coat. Fill that inch before the concrete has set, if possible, with stiff mortar made of cement, and clean, coarse sand, equal parts; first mixing thoroughly, dry and wet. Level it with the straight edge from the top of the strips. After lying awhile, float, and then trowel to a surface. Avoid dusting the surface, if possible. Avoid troweling too long or air cracks will result. Never use pure cement for dusting, but equal parts of fine sand and cement mixed. Bevel the four sides of each block. Be careful not to break the edges in removing the strips. Keep the surface free from dirt and dirty water, that the color may be clear and uniform. Wet the walk thoroughly three times a day for ten days, not allowing anything on it during that time. Protect the surface against hot rays of the sun, and against currents of air when possible. For this purpose, canvas, boards, and corrugated sheet iron are used. Such four inch walks will require seven to eight pounds of cement to the square foot. For inside walks, two parts of sand to one part of cement will do for the topping. For walks on business streets, mix ½ to 1 pound of lamp black with each barrel of cement. Prussian blue will make a bright blue and caput mortuum will make a bright red stone, but is expensive. Venetian red is cheaper, but not so good."

PAVED AND DIRT ROADS COMBINED.

DURING the summer of 1891, the project of constructing a permanent road between the city of Bloomington and the town of Normal, Illinois, was agitated with considerable vigor and enthusiasm. The distance to be built was about 1½ miles. The soil is the ordinary black loam, which becomes so muddy when it is wet and so hard and smooth when it is dry. No hard road material is near by. Plans of various kinds of roads were proposed and discussed. To make a complete paved road like the city streets, with stone or plank curbing, was too costly, and besides for a general mixed travel it was generally conceded that a dirt road, when dry and smooth, was preferable to any other that could be constructed. The result of canvassing the matter fully was the adoption of a roadway combining the excellence of both, which could be built at an expense not considered expensive. The plan was proposed by

Dr. Z. Waters, of Bloomington, and would have been carried out had not financial difficulties arisen which prevented the execution of the plan at that time.

The road consists of a paved center road-way made of good paving brick. In the place of curbing for the purpose of holding the brick in position, the outer edges of the roadway are arched or curved downward so as to be supported by the firm earth. Just inside of the ends of the brick on each side of the center are laid tile drains about 18 inches deep, and parallel with the road center, for the purpose of keeping the road-bed dry, and especially for keeping the earth firm at the outer edge of the pavement. The pavement is 18 feet wide, but the outside foot on each side is taken up in making the curve, leaving an available brick roadway of 16 feet. The earth is drawn over the outer curve or arch, so that a well prepared earth road is left on each side, which it is expected will be generally used during the summer and fall, when earth roads are good everywhere, but when too wet for use the hard road will be used, leaving the dirt road to dry without being ruined by travel when it is not suitable for use.

The following is a description of the manner in which the road is to be built: The bed is to be prepared by excavating sufficient earth for the pavement, so that the surface of the pavement and dirt roads at the sides will be left at the desired grade when the work is finished. The sub-grade for the pavement should be eleven inches lower than the top of the pavement when finished. Tile drains on either side should be laid about eighteen inches deep, just inside the outer border of the brick, and the trenches filled with porous material like coal cinders, though we do not think this is at all essential. After the road-bed is prepared and made the proper shape, it is to be rolled well with a heavy roller, after which a covering of coal cinders, two inches thick, shall be spread evenly, and well rolled. Upon this a covering of sand must be placed to form a bed upon which to place the foundation brick. Upon this prepared bed a course of brick is to be laid flatways, the long way of the brick in the direction of the road. A covering of sand should be placed on this course of brick and brushed into the crevices, and sufficient left on the top to form a bed for the surface brick. Good paving brick should now be laid on edge with the long dimension of the brick cross ways of the road. The curved part of the pavement at the outer edge, however, should be laid with the long dimensions of the brick, parallel with the line of the road, so that the curve may be well made, and also for the purpose of properly resisting the impact of loads as they are drawn on and off the pavement. The work is finished by placing a coat of sand upon the surface, and sweeping it into the crevices and rolling with a heavy roller. The earth is well drawn over the outer edges of the brick, and the outer surface ditches cleaned and graded to carry off the water, and the road is constructed and ready for use.

The points claimed for this road are: First, it secures the excellence of the city paved street, and also the acknowledged beauty of the country road in its season. Second, it admits of early cleaning and repairs. Third, it is one of the most durable roads, when good material and workmanship are employed.

The estimated expense of the road completed was about forty-one dollars per lineal rod. While this expense is more than a country road can bear, yet for a heavily traveled road—which is almost a city street in the volume of travel which must be provided for—it is cheap, and can be profitably built. The part that is paved is equal to any street pavement, while the cost is less than half that usually expended. It is a question whether this kind of road may not be very profitably constructed in the streets of many of our smaller towns, where the expense of complete paved streets prevents all attempt to make their main thoroughfares any better. We need a system of improvements for our smaller towns which is adapted to their necessities, and still keep the expense within paying limits. May not the above described road be one of the improvements in this line?—*C. G. Elliott, in Drainage Journal.*

KINDS OF PAVEMENTS IN SOME AMERICAN CITIES.

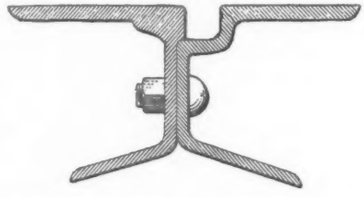
THE following table shows the distribution of the kinds of street pavements in the different cities of the United States:

	Washington. (1890) Per cent.	St. Louis. (1890) Per cent.	Chicago. (1890) Per cent.	Buffalo. (1890) Per cent.	New York. (1890) Per cent.	Philadelphia. (1890) Per cent.	Boston. (1891) Per cent.
Sheet asphalt	26.07	0.94	0.76	30.49	3.44	3.23	0.96
Coal tar	23.06	.....	.....	.....	.....	.....	.....
Asphalt block	5.19	.....	0.62	.....	.....	2.47	0.11
Block stone	14.18	29.07	3.45	40.45	67 61	15.69	15.94
Wood	0.18	1.25	61.27	.....	.....	.....	.....
Cobble	6.94	.....	.....	.....	0.70	49 21	1.37
Vitrified brick	.....	.....	.....	0.02	.....	2.60	0.08
Rubble	.....	.....	.....	.....	.....	15.16	.....
*Telford	.....	4.34	.....	0 29	.....	.....	10.00
*Macadam	4.83	64.40	33.90	28.75	5.10	11.64	37.07
*Gravel	19.55	.....	.....	.....	23.15	.....	34.47
	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Mileage	165.70	421.97	669.64	347.75	475.16	762.20	434.59

*Not usually separated in the reports of the various cities.

A GERMAN TRAMWAY RAIL FOR PROTECTION OF PAVING.

THIS rail, illustrated in the *Zeitschrift fuer Transportwesen und Strassenbau*, from which we abstract this note, is to be constructed in two parts; and the top flanges are made exceptionally wide so as to give a wide track for ordinary vehicles, in order to prevent the formation of ruts on each side of the rails, which has proved so detrimental to the paving when the ordinary narrow rails are used. The foot and sides of this rail are to be imbedded in concrete. The tamping under the top of the flanges has to be done with special care, as the rail might either be tipped to one side or fractured



A RAIL FOR USE ON PAVED STREETS.

without such solid bearing. The rail evidently was primarily intended for use on streets which already have a concrete foundation for paving.

A CHEAP KIND OF PAVEMENT.

To the Editor of Paving and Municipal Engineering:

SIR—We expect to pave our principal business streets with vitrified brick. This season we will lay about 15,000 yards. The system adopted after careful study of the paving question in a number of Ohio cities, is as follows: Excavation twelve inches, sub grade rolled with seven ton roller, six inches gravel, two inches sand, brick laid without tar or cement, rolled with same roller, crowned in center for fifty foot street, about six inches, curb of native or Berea sandstone.

Inasmuch as our contracts have not been let, we can not say how much it will be per square yard, but don't expect to pay much over one dollar and thirty-five cents per lineal foot for curb set.

There is considerable difference of opinion as to what kind of brick is the best, *i. e.*, fire-clay or vitrified shale, but the consensus of opinion is in favor of the vitrified shale, burned in a "down-draft" kiln.

S. J. HATHAWAY, Ch'man Paving Committee.

Marietta, Ohio, June 30, 1892.

A NEW KIND OF CURBING.

H. H. WAINWRIGHT'S "Anchor Artificial Curb" seems likely to come into general use soon. It has already been adopted by companies in Washington and Baltimore, and a company is organizing in New York to introduce it there. Its advantages over the stone and cement curbs are that it is not so easily broken under the impact of wheels of vehicles, and it is claimed for it that it can be laid at much lower cost than granite curbing. It is provided on the outside edge with an iron plate, which is galvanized and is thus prevented from discoloring the curb. The bars of angle iron which form the front and back of the bottom and the tie rods imbedded in the concrete for its entire length, give it strength equal to granite, and make it, according to the claims of the inventor, absolutely non-breakable. It is also provided with anchor plates in a manner calculated to make it immovable. The advantages and merits claimed for it, together with its cheap cost, are enough to create a general demand for it.

WORK IN BURLINGTON, IOWA.

THE report of William Steyh, civil engineer of Burlington, Iowa, shows that during the last year 16,815.4 square yards of brick pavement were laid under his supervision, and 6,903.8 lineal feet of curbing set, at a total cost of $30,753.03. During the same period, $7,604.25, was spent in the construction of new sewers.

COST OF GRANITE PAVING IN DETROIT.

To the Editor of Paving and Municipal Engineering:

SIR—Mr. W. W. Thayer, C. E., in an article on street paving in your June number, puts the cost of granite paving, "or Guidet," on concrete foundation too high. The last contract let here was for $3.25 per square yard of finished surface.

ESTIMATE COST.

1 square yard 24 or 26 Block delivered on street	$2 00
1 square yard or ⅓ cubic yard concrete, at $3.60	60
1 square yard or ⅛ cubic yard excavation, at 40c, say	07
Labor of laying, cushion sand, ramming and pitching	40
Cost per yard complete	$3 17

Thousand Island dressed granite is used. Louisville or Utica cement.

P. W. KEATING.

Detroit, Mich., June 17, 1892.

PERSONAL.

Mr. E. L. Shaw has been appointed city engineer of Marinette, Wis.

George Bailey has been appointed superintendent of waterworks at Albany, N. Y.

Arthur Lagron is engaged in constructing over twenty-two miles of sewers at Freeport, Ill.

Mr. Torrence E. Crider, county surveyor of Butler county, O., in 1882, died at Hamilton, O., June 29, at the age of thirty-seven.

G. S. Chapin, formerly assistant engineer on the sewers at New Rochelle, N. Y., has been appointed superintendent of sewers at that place.

Thomas C. Clark is the engineer appointed to prepare the plans and supervise the construction of the new bridge over the Harlem river at Third avenue, in New York City.

M. R. Sherrerd has resigned the position of assistant city engineer of Peoria, Ill., to go into partnership with P. H. Baerman in the Troy Engineering Company, Troy, N. Y. Mr. Baerman has recently been appointed city engineer, of Troy, N. Y.

PATENTS.

V. H. LOCKWOOD, patent attorney and solicitor, No. 60 East Market street, Indianapolis, reports the following patents of interest to our readers issued during the preceding month. Copies can be procured of him if desired:

Steam Shovel. No. 476,808. J. Nichol, Chicago, Ill.

Road Scraper. No. 476,691. B. F. Shuart, Billings, Mont.

Road Scraper. No. 476,262. J. A. Grant, Mt. Pleasant, Ia.

Waste Trap. No. 477,499. G. F. Brown, Philadelphia, Pa.

Cistern Cleaner. No. 477,567. G. W. McConnell, Hall, Mo.

Street Curbing Block. No. 477,722. S. A. Webb, Columbus, O.

Adjustable Pipe Closer. No. 475,793. W. P. O'Brien, St. Paul, Minn.

Artificial Stone. No. 477,847. Wilhelm Reissig, Munich, Germany.

Paving Block. No. 475,924. S. Breden and J. Sheridan, Franklin, Pa.

Excavating Apparatus. No. 477,837. J. T. Dougine, Chicago, Illinois.

Electric Street Lamp Post. No. 476,739. T. Flaherty, Pittsburgh, Pa.

Machine for Applying Cement. No. 478,034. A. J. Thompson, Montrose, Cal.

Concrete Mixer. No. 477,361. G. F. Gray & H. N. Gray, San Francisco, Cal.

Sewer, Water and Drain Laying Device. No. 478,024. E. H. Rose, Colton, Cal.

Excavating and Shoveling Machine. No. 477,933. E. Hennebery, Duluth, Minn.

Street Electric Light Mast Arm. No. 476,607. J. H. Caldwell. Philadelphia, Pa.

Street Sprinkling Machine. No. 477,481. F. Winkler & L. Winkler, South Bend, Ind.

Light Transmitting Floor or Side-walk. No. 477,148. G. W. Parker, San Francisco, Cal.

Conduit for Electric Street Railways. No. 476,128. W. F. Carr and C. F. Ferrin, Minneapolis, Minn.

Artificial Stone. No. 476,542. J. H. Kleb, Newark, N. J., assignor of one-half to F. W. Kleb, same place.

Method of Manufacturing Artificial Granite and Marble. No. 477,326. Chas. George, Berlin, Germany.

Pipe Coupling. No. 476,188. Joseph Connor, Philadelphia, Pa. Assignor of one-half to A. J. Fuller of same place.

Composition Brick. No. 477,632. A. S. Baker, Sandy Creek, N. Y. Assignor of one-half to G. J. Woodward, same place.

Manhole and Sewer Connection. No. 476,440. J. P. Bates, Springfield, Mo. Assignor of one-half to A. Donaghy, same place.

Asphalt Paving Apparatus. No. 476,814. A. H. Perkins, Chicago, Ill. Assignor to the Western Paving and Supply Company of Illinois.

Hydraulic Excavator. No. 475,936. W. M. Douglas, Galveston, Texas. Assignor of one-half to the Bucyrus Steam Shovel and Dredge Company, Bucyrus, O.

C. W. RAYMOND & CO., of Dayton, Ohio, have issued, in unique style, a pocket edition of their catalogue, which gives in a striking and impressive way all desired information regarding their excellent paving brick and clay-working machinery, with illustrations. Every person interested in the business should send for it, as it is not only valuable to possible buyers, but contains much useful information, and is typographically a beautiful production.

Improvement and Contracting News.

PAVING.

Bedford, Ohio, has voted to pave streets.

Sioux City, Ia., is paving her streets extensively with bricks.

The streets of Goldsboro, N. C., are being paved with shell rock.

The paving of State street at Painesville, Ohio, will cost over $25,000.

Brady street, Milwaukee, Wis., is about to be paved with cedar blocks.

The laying of the brick pavement on Third avenue, Rock Island, Ill., is progressing rapidly.

Dunlap, Iowa, is having a survey made of her principal streets and re-establishing the grades.

Bituminous rock on a concrete foundation is being laid on Third street, Portland, Oregon.

Snelus & Son have over 5,000 feet of cement walk contracted for to be laid in Ashtabula, Ohio.

Hampton, Ia., will put down several blocks of brick pavement to test the quality and durability.

There are 487 miles of macadamized roads in West Virginia, distributed among seventeen counties.

The citizens of Rutherford, Bergen Co., N. J., have voted $50,000 for macadamizing and $25,000 for sewers.

The paving of West Walnut street, between Twelfth and Fifteenth streets, Des Moines, Ia., is completed.

The Highland boulevard at Milwaukee, Wis., is being extended beyond Twenty-first and twenty-third streets.

At Duluth, Minn., the paving on Second and Third avenues, east, is completed, and the space between the curb and sidewalk sodded.

By a vote of the highway committee of Brockton, Mass., $1,000 will be spent in improving Crescent street, and $300 on Cary street.

H. B. Smith was let the contract for clearing, grubbing and paving Broadway, Everett, Wash., a distance of two miles, at a cost of $25,000.

It is said that the council of Lynchburg, Va., passed an ordinance relative to paving. Main street and Broadway south to Pearl will be paved.

The appropriation for new streets this year at Alexandria, Va., is $7,000, and the work now begun is on the extension of North Columbus street.

The contract awarded Albert Gleason to grade a portion of Morgan street, Washington, D. C., has been canceled, and the work given to L. Vandin & Co.

James Frawley has the contract to sweep and clean the paved alleys in Washington and Georgetown for one year from July 1, 1892, at 33 cents per 1,000 yards.

After long consideration, the board of public works of Columbus, Ohio, finally awarded N. B. Abbott the contract for improving Livingston avenue from High street to Kelton avenue. Hayden block will be laid on a stone foundation, with tar filling.

Main street, Mt. Vernon, Ohio, is to be paved with fire brick, or fire blocks, proposals for which will be received until August 1st at the city clerk's office.

Adel, Ia., is falling in line with the average American cities in regard to street improvement, and has let a contract for curbing and paving one of its streets.

Mulberry street from Seventh to Eleventh streets, at Des Moines, Iowa, is being paved with brick. Ninth street, from Pleasant to Center, will also be paved.

The city council of Anderson, Ind., has awarded contracts calling for nearly $100,000 in brick street paving. A $60,000 extension will also be made to the waterworks.

Stevens Point, Wis., has contracted for putting down 22,000 yards of cedar block paving and laying 3,000 feet of sewer pipe, so we are informed by the city and county surveyor.

One hundred and seventy-five thousand granite blocks and one hundred and thirty-five thousand square feet of flagstone sidewalks will be put down at Charleston, S. C., this year.

Palmer & Palmer of Frankfort, Ind., will receive sealed proposals until July 19th for constructing six and one-half miles of gravel road. The contract will be let in two allotments.

The citizens of Monongahela City, Pa., voted to increase the indebtedness of the city by issuing $50,000 in bonds for the purpose of constructing sewers and paving the streets.

Eighteenth avenue is to be made into a beautiful new boulevard, forming, with the paving of Eighteenth street, a fine drive from the union depot to City Park, at Denver, Colo.

Sealed proposals will be received by the city clerk of Akron, Ohio, until July 23d for furnishing material for and laying sidewalks and crossings for said city for the ensuing year.

A large number of the residence streets are being paved at Indianapolis, Ind., with asphalt. The entire cost is assessed on the abutting property-holders—averaging about $7.50 per foot.

The contract for grading 4,750 cubic yards of Q street to the Eckington and Soldiers' Home railway tracks at Washington, D. C., has been awarded to Mr. F. Talty at 20 cents per cubic yard.

Street paving in West Duluth, Minn., is being pushed by the various contractors, and every man who wants to work is given an opportunity. West Duluth will spend $400,000 on her streets this season.

Waterbury, Ct., now owns a stone crushing plant, and the council authorized the purchase of a steam road roller, and it is expected that macadamized streets will begin to make their appearance soon.

An effort is being made at Chicago to complete the driveway of the boulevard system before the opening of the World's Fair. When completed the boulevard will have a sidewalk on each side eight feet wide; next to these will be grass plots twelve feet wide, then roadways for traffic teams, each twenty-five feet wide, and in the middle will be the pleasure-drive, 160 feet wide.

The council of St. Bernard, Ohio, has accepted a bid of Mr. Frank Knoll, of Covington, Ky., to put cement sidewalks on Carthage pike. His bid was for 83 cents per running foot for a six-foot sidewalk.

The board of freeholders of Middlesex county, N. J., have decided on an appropriation of $20,000 for improving the roads of the county. The road between New Brunswick and Metuchen will be macadamized.

Dubuque, Iowa, will grade, gutter, curb and macadamize Twenty-fourth, Twenty-fifth and Twenty-sixth streets, from Couler avenue to Jackson street. Air Hill street, from Julien avenue to West Eighth street, this year.

The people of Augusta, Ga., are becoming thoroughly aroused to the necessity of having the streets of that city paved in a manner that will be durable and attractive, and are very enthusiastic over the asphalt paving now being done on Broad street.

D. J. Kennedy was awarded the contract for paving Fourth avenue, Bay City, Mich., from Madison avenue to Johnson street, at a bid of $15,098.73. Some of the property owners on Fourth avenue object to the improvement, but the majority are greatly in favor of it.

The paving commissioners of Ithaca, N. Y., awarded Costello & Nagle of Elmira, the contract for paving South Aurora street from State street to the bridge and East State street from Aurora to the foot of the hill with vitrified brick on concrete bottom, thirty-six feet wide.

The matter of street paving at Cleveland, O., is being pushed forward at a rapid pace during the present season. Nearly $1,000,000 will be expended the coming year in paving, and many streets that ought to have been paved long ago will be put in first-class condition.

The following contracts have been let for street work at Toledo, Ohio: Paving Dove lane with Medina stone and Berea curb, H. P. Streicher, at $1,430.09; Fourteenth street, vitrified brick and Medina curb, William McMahon, $2,543.13; Chase street, Thomas Terrill.

Sealed proposals will be received until July 26th, at Norwood, Ohio, for the improvement of Floral avenue from Hudson avenue to the south corporation line, by grading and paving the roadway with Trinidad sheet asphalt and constructing the necessary culverts and drains.

At Springfield, Mo., articles of incorporation were filed for the Springfield and River Park Turnpike Company, formed for the purpose of building a pike from Springfield to Ozark. The articles were taken out for fifty years, and the capital stock of the company is $70,000.

The board of public works of Newark, N. J., has awarded the Barber Asphalt Company contracts to pave Techenor street, $2.87 per yard; Grant street, $2.83 per yard; Washington place, $2.87 per yard; Washington street, from Broad street to Washington Place, $2.87 per yard; Oriental street, $2.80 per yard. The same company was awarded the contract to pave James street at the rate of $2.87 per yard for asphalt and $2.40 per yard for granite.

Twenty thousand dollars worth of public works has been let at Kansas City, Mo. It consists of curbing several streets and paving Central, Ninth to Tenth; Fifth, Walnut to Grand; Garner, Walrond to Indiana; Park, Lexington to Independence, and Walnut, Twentieth to Belt railway.

At Nashville, Tenn., Vine street is to be re-graded between Taylor and Monroe streets, and the board of public works awarded to W. G. Bush & Co., a contract for laying sidewalks on Watson street, between Second and Fourth. Spruce street, between Church and Broad, will be paved.

The special street paving committee of Zanesville, Ohio, reported plans and specications for the paving of several streets. Among them Second street from Main to Market, Fifth from South to the Canal, Seventh street from Main to Marietta street, South from Third to Eighth, and several others.

The county commissioners have decided to build a boulevard across the bottoms from West Third street on P street to the railroad track by Holmes brick yard, at Lincoln, Neb. The new improvement will be forty feet wide. Patsy Mears was awarded the contract, and the entire work will cost about $5,000.

The board of public works of Kansas City, Mo., has approved ordinances to macadamize Holmes street, from Third to Fifth street; to pave the north half of Thirty-first street from Holmes to Main street; to pave Twelfth street from Pennsylvania avenue to the east end of the Twelfth street viaduct.

The streets and highway committee of the town board of Oak Park, Ill., called a meeting of the property owners to get an expression of their sentiments in regard to paving the east and west streets. The meeting was largely attended and the entire sentiment of those present was in favor of improving them.

The mayor of Atlanta, Ga., and a part of the council and Col. McCollum, superintendent of the W. & A. R. R., made a visit to Chattanooga, Tenn., for the purpose of inspecting the different kinds of pavement there in order to prepare themselves to vote intelligently hereafter on the different kinds of paving best for Atlanta.

John T. Lellyett and the Southern Construction Company, of Chattanooga, Tenn., were awarded a contract, jointly, to pave Spruce street, from Church to Broad streets, at Nashville, Tenn. The first-named will furnish the brick and the latter will lay them. The price is $1.40 per square yard, and the work will be completed by September 1.

It has been ordered that the Barber Asphalt Paving Company be required to resurface E street from New Jersey avenue to North Capitol street., N. W.; repair F street from New Jersey avenue to North Capitol street, and re-surface G street between New Jersey avenue and North Capitol street, or repair it where it does not need a new surface, at Washington, D. C.

At the recommendation of the board of public works, the common council of Bay City, Mich., ordered a new pavement to be laid on Center avenue. The material provided for is white pine blocks 4x5 inches, to be laid upon two thicknesses of boards with a sand foundation. The pavement will be 64 feet wide from Water street to Madison avenue, and 56 feet wide from Madison avenue to Johnson street. The estimated cost is $70,000.

SEWERS.

The sewers at Piqua, Ohio, are to be extended.

Sewer bonds for $21,000 have been sold at Halifax, N. S.

A tile sewer will be built in North Fourth street at Troy N. Y.

About 5,000 feet of branch sewers will be built at Ionia, Mich.

The council of Middletown, N. Y., has voted in favor of several sewers.

Work has commenced on an extensive sewerage system at Austin, Texas.

At Ishpeming, Mich., 22,240 lin. ft. of 8 to 36-inch sewers are to be built.

It is said that steps will be taken to construct a sewerage system at Buxton, Me.

A committee has been appointed to secure a sewerage system for Sidney, N. Y.

Plans for a system of sewers to cost $350,000 have been prepared for Cicero, Ill.

The estimated cost of a sewer in the thirteenth district, at Scranton, Pa., is $10,940.

A new $7,000 sewer was ordered by the council of La Fayette, Ind., for the seventh district.

Eighteen thousand feet of main and lateral pipe sewers will be laid at Carbondale, Pa.

W. H. Manderville was awarded two sewer contracts at Olean, N. Y., at $17,766 and $15,188.

It is said that a company is being formed to construct a system of sewers for Mount Morris, N. Y.

At Lebanon, N. H., a special meeting is to be held to discuss the question of a sewerage system.

About twenty-five miles of brick and vitrified pipe sewers will be laid at Glens Falls, N. Y., this year.

Plans for a system of sewers for Boone, Iowa, are being prepared by M. R. Laird, Engr. of Des Moines.

The contract for a sewer in Walnut street at Reading, Pa., has been awarded to A. H. Tyson at $12,536.

The Lansdowne Sewerage Company has been incorporated at Lansdowne, Pa., with a capital of $5,000.

Ten miles of sewers and eight and one-half miles of paving will be constructed at Des Moines, Ia., this season.

The engineer of Salt Lake City, Utah, has prepared plans for 10,956 feet of sewers, estimated to cost $33,528.

The people of Oregon City, Ore., are at work getting ready to provide that city with a proper system of sewers.

The contract for the Ninth street sewer at Altoona, Pa., has been awarded to Bowman Bros, McKeesport, at $28,000.

A total of 49 miles of sewers will be built at Knoxville, Tenn., two miles of brick sewers and 47 miles of pipe sewers.

The proposed extension of the intercepting sewer at Columbus, Ohio, is estimated by the city engineer to cost $81,400.

The council of Clifton Forge, Va., has voted to employ an engineer to examine the drainage of the town with a view to introducing a general sewerage system.

J. W. Blackman was awarded the contract for constructing a sewer in Moler street at Columbus, Ohio at a bid of $21,438.

The surveys have been completed for a system of sewers about five miles long at an estimated cost of $100,000 at Jamestown, N. Y.

The Denny Fire Clay Co., of Seattle, Wash., was awarded the contract to furnish sewer pipe for the new system at that place.

The Stanwix Engineering Co., Rome, N. Y., is preparing surveys and preliminary work for a proposed sewerage system at Ilion, N. Y.

Plans for a sewer system for Stamford, Conn., have been prepared by J. P. Bogart, Bridgeport. $30,000 to $40,000 is the estimated cost.

At Aurora, Ill., the sewer system on the west side is nearing completion and the east side will also have a system in the near future.

The sewerage committee of Emporia, Kan., have been instructed by the City Council to order 3 car loads of 15-in. sewer tiling at once.

A company with $25,000 capital has been formed at Wayne, Pa., for the purpose of perfecting the drainage system between Paoli and Ardmore.

Sealed proposals for the construction of a forty-eight inch circular brick sewer on Sixth street, north, at Great Falls, Mont., until July 18th, by the city clerk.

The citizens of Red Wing, Minn., are seriously considering the subject of extending the sewerage system of the city, which is outgrowing the present system.

The Union Storage Company was awarded the contract for a large quantity of sewer pipe and supplies by the council committee on sewers at Minneapolis, Minn.

The city council of New Bedford, Mass., was asked for a special appropriation of $3,200 for building sewers in Belleville avenue, No. 2, and South Front street, No. 5.

McCauley & Flemming have been awarded the contract for constructing a big sewer on West Grand Avenue, Des Moines, Ia. The bid submitted was $1.47 per foot, and the sewer completed will cost about $8,000.

Sewers will be built at Bancroft street, from Monroe to Central avenue; in the alley between Oswald and Pratt streets from Second to Fourth streets, and in Second, Pratt, First and Bridge streets at Toledo, Ohio.

The council of Los Angeles, Cal., has voted in favor of the proposed outfall sewer to cost $360,000 and an election will be called to vote on the issue of bonds. It is estimated that an additional $90,000 will be required for laterals.

The proposed sewer between Sixth and Race streets at Lock Haven, Pa., will require 3,850 ft. of 30-in. pipe, 3,100 ft. of 20-in. and 1,900 ft. of 15-in. The head of the sewer will be 4 ft. deep, and the outlet 17 ft. $13,000 is the approximate estimate.

Work has begun on the Thomas Creek sewer at Portland, Ore. It extends from near First and Abernethy streets to the river and will cost in the neighborhood of $40,000. The sewer will be built of brick and stone, and Messrs. Bates and Jeffrey are the contractors.

N. J. Conover, Freehold, N. J., and A. H. Tyson, Reading, Pa., have prepared plans and estimates for sewers on the separate system for Freehold, N. J. The estimates are $24,300 and $29,285 for 7.4 and 8.8 miles, respectively, of 8 to 10-in. pipe sewers.

Middleboro, Mass., is considering the introduction of the union system of sewerage disposal by which the solids are separated from the liquids. Grease is extracted and the residue converted in a valuable fertilizer, while the water is discharged perfectly purified.

Washington, D. C., sewerage system is bad and the demands of safety and health require an entirely new system. The sewers are of insufficient capacity and slopes and faulty shapes to allow the sewage to flow rapidly away and therefore is the cause of much disease.

Great indignation is expressed at Orange, N. J., at the prospect that the sewerage system which is being constructed in that city will cost $300,000 more than the original estimate, and perhaps twice as much, or $1,000,000, when the original estimate was between $500,000 and $600,000.

Montreal, Canada, is engaged in constructing an extensive sewer system in the eastern section of the city. It is 3x2 and sixteen feet deep. Sectional vitrified clay sewer is being used. It is in four pieces—a bottom, two sides and a top, and is said to be quite a saving over brick in both time and cement.

The initial step toward introducing a system of sewerage for Brockton, Mass., has been taken by the aldermen, they having passed an order appropriating $15,000 to be used by the sewerage commissioners for the necessary surveys and plans. The system to be introduced is that of the broad irrigation and downward filtration.

The sewer to be built in Washington Street from Noble to the eastern line of the corporation at Indianapolis, Ind., will be about one and one-half miles long and cost $70,000. It will be followed in due time by other sewers, all to be constructed under a general plan, which when completed, will furnish a complete and adequate sewer system.

On the first day of this month the new garbage system went into effect at Washington, D. C. Contractor Clark, who has charge of the work, put on 18 carts the first morning and about ten more will be put on as soon as finished. It is the intention to give the city a tri-weekly service with a daily service at the markets, hotels and large boarding houses. They are new steel carts from which no stench can arise, and make a much nicer appearance than the old wagons laden with barrels.

WATER-WORKS.

Pecatonica, Ill., has been treating itself to water-works.

Cripple creek, Colo., will have a system of water-works.

At Cuero, Tex., the water-works system is being extended.

It has been voted to establish water-works at Grinnell, Ia.

Sturgis, S. D., is constructing water-works at a cost of $75,000.

Dillon, Mont., voted to expend $25,000 in constructing water-works.

The water-works mains of Hallettsville, Tex., are being extended.

Lagrange, Ind., will vote on the proposition to build water-works.

Onsett, Mass., is getting ready to introduce a water supply system.

The water supply for Salineville, Ohio, will be secured from ten large wells.

Cambridge, Md., is to have water-works, provided they can get them for $50,000.

A proposed system of water-works for Strathroy, Ont., is estimated at $30,000.

Fifteen thousand dollars is the estimated cost of water-works for Ellicott City, Md.

Messrs. Wood, Harmon & Co. will construct water-works at Ruxton Heights, Md.

Valejo, Cal., has voted to issue bonds for $250,000 to build water-works to be owned by the city.

The water-works are completed at Atalla, Ala., and the water is the finest and best quality.

Shenandoah, Pa., voted by a big majority to borrow $95,000, with which to build new water-works.

Homestead, Pa., is proud of its new water-works. The entire cost will amount to over $100,000.

The Independence, Mo., Water-works Company has been incorporated with a capital of $35,000.

Birmingham, Eng., has voted £6,000,000, or $30,000,000, to bring a supply of pure water from the hills of Wales.

The Bloomington Water-works Company has been incorporated with a capital stock of $50,000, at Bloomington, Ill.

The city of Houston, Texas, has a good system of water-works and is supplied with the purest artesian water.

Covington, Ind., is to have a system of water-works and electric lights—to be in operation on December 1, next.

The citizens of Syracuse, Neb., met and decided to put in a system of water-works, and also an electric light plant.

At Brownwood, Tex., the water mains will be extended two and one-half miles through the residence part of town.

The estimated cost of the proposed water-works for Troy, Ala., is $37,000. N. W. Davis, of Atlanta, Ga., is the engineer.

Auburn, N. Y., has decided by a large majority in favor of municipal instead of corporation ownership of water-works.

Messrs. Davis & Symons have received the contract to construct water-works for the new military post near El Paso, Texas.

An abundance of water has been obtained from the well for the water-works in the Southeast Portland tract at Portland, Ore.

Athena, Ore., will soon have a new water-works system consisting of a small pumping station, principally for fire protection.

Work is progressing nicely on the water-works plant at Metropolis City, Ill., and the city expects both water and lights by the 1st of September.

The council of Garfield, Wash., is taking hold of the matter of water-works with considerable vigor, and the prospects are that a good system will be in operation before long.

A company has been organized with a capital stock of $10,000 and secured a charter for the purpose of giving Duquesne, Pa., a complete water service.

The present system of water-works at Evansville, Ind., is wholly inadequate to the demands of a city its size, and a speedy and efficient remedy is desired.

The water-works company at Chattanooga, Tenn., will put in additional filters of 1,000,000 capacity. The contemplated improvement will cost about $75,000.

The board of public works of Indianapolis, Ind., ordered the Indianapolis Water Company to make the 20,000 feet extension of mains that the contract calls for.

The water company at Alliance, Ohio, will expend from $50,000 to $75,000 on the water plant this summer and fall. New station pumps and stand-pipe to be provided.

The mayor of Lancaster City, Pa., has been authorized to effect a loan of $150,000 for the construction of a new reservoir and the general improvement of the water supply.

It has been decided by the city council of Decatur, Ill., to spend about $9,000 at once for larger water mains. A circuit of twelve and sixteen inch mains is to be laid that will take in the entire manufacturing district.

The contract for a complete system of water supply for the village of Walden, N. Y., has been awarded to the Pierce Company of Goshen. The supply will be taken from artesian wells and will cost in the neighborhood of $40,000.

R. A. Jones, of Spokane, Wash., has been let the contract for building a system of water-works at Rothdrum, Wash. The company has located its water right 5,000 feet from the town on the mountain side, and 10-inch mains will be put in.

The Western Water Company has recently been chartered at Harrisburg, Pa., with a capital stock of $7,000,000, to furnish Pittsburgh with pure mountain water. The plan to pipe the water is a feasible one and surveys are being made. The fall in elevation is between 300 and 400 feet.

Mayor Mosby, of Cincinnati, Ohio, has named Dr. T. W. Graydon, A. Howard Hinkle, Dr. J. W. Prendergast and Henry Haacke, as water-works commissioners to be sole trustees and to have the full control and disbursement of the $6,000,000 to be expended for water-works for that city if the people vote in favor of the works at an election to be held on the 20th of this month. This election must result in a popular declaration in favor of the new works, or the whole thing falls. The naming of the commission is preliminary as nothing can be done until the people have voted.

The flume which conveys the water from the mountains to the reservoir, at San Diego, Cal., is said to be the largest and longest thing of the kind in the world. It is thirty-five miles long, and is composed almost wholly of redwood two inches thick. This monstrosity in the form of a flume crosses 315 streams and canyons on trestles, and passes through eight tunnels which are each 6x6 feet in size, with convex roof. Building a water-tight box 35 miles long is a gigantic undertaking, and was believed by many could never be accomplished, but the result has proved different.

BRIDGES.

A new iron bridge is to be built at Quinton, N. J.

A new steel bridge will be built across the river at Napa, Cal.

It is proposed to erect a bridge at State street, Portland, Me., to cost $4,000.

An iron bridge 118 feet long will be built across the James river at Redfield, S. D.

A new bridge will be built across the Farmington river, at Poquonock, Conn.

Cook county, Ill., has awarded a contract for a $2,500 highway bridge in that county.

The President has approved the act for a bridge across the Mississippi river at Moline, Ill.

A steel arch bridge will be built over Scajaquada creek, on Elmwood avenue, at Buffalo, N. Y.

Plans are being prepared for a viaduct 120 feet long over the railway tracks at Eau Claire, Wis.

A new overhead bridge will be built by the Pennsylvania railroad in Downington, Pa., at Chestnut street.

An appropriation of $45,000 has been made for an iron bridge over Kinnickinnie river at Clinton street, Milwaukee, Wis.

It has been voted to raise $5,000 to build an iron bridge across Racket river at Colton, N. Y., to take the place of a wooden bridge.

At Lawrence, Mass., the common council adopted the order for the construction of a bridge across the Spicket river at Bennington street.

The Homestead and Pittsburgh Bridge Co. will construct a bridge over the Monongahela river, in Allegany county, at Pittsburgh, Pa.

Hoffman & Bates received the contract for the construction of a bridge across the Sandy river at Troutdale, Ore., in consideration of $6,230.

A new double-track bridge is to span Pequabuck river on the New York and New England Railroad at Plainfield, Conn. It will be built of iron.

The President has approved acts for a bridge across the Illinois river, near Havana, Ill., and for one over the Tennessee river, near Cliffton, Tenn.

Thomas C. Clarke is the engineer appointed to prepare the plans and supervise the construction of a new bridge over the Harlem river at New York City.

At New McKeesport, Pa., a $50,000 foot bridge will be erected to connect Boston and Grenoak. A $6,000 bridge will also be constructed between Suter and Douglas.

The Gloucester county (N. J.) board of freeholders has approved plans for a new iron bridge to span Woodbury creek, that county, and the cost is not to exceed $10,000.

Superintendent of Streets Black, of Chelsea, Mass., will give details of the dilapidated condition of the old bridge over Chelsea creek, between Chelsea and Revere.

The King Bridge Company, of Cleveland, O., was awarded a contract for a steel and iron foot and wagon bridge to be erected across the Youghiogheny river at Boston.

At San Francisco, Cal., the property owners of Charles street have petitioned the board of supervisors to erect a bridge at the intersection of that street and the railroad crossing.

The Chicago West Side Park commissioners have decided to build draw bridges over the west fork of the South branch at California avenue and over the canal at Weston avenue.

The St. Augustine Bridge Company has been incorporated at St. Augustine, Fla., with a capital stock of $50,000 to build, maintain and operate a toll bridge between St. Augustine and Anastasia Island.

It has been decided by the board of freeholders at Paterson, N. J., to build a $1,200 stone arch at Shadyside, a $1,000 one at Central avenue, between Maywood and Hackensack, and another, costing $1,000, on the same avenue near the Hackenseck depot. Also a $1,200 bridge across Saddle river near the stone church was ordered, and the board reconsidered its former action in regard to the Hillsdale bridge, appropriating $2,000 for a new iron structure.

STREET LIGHTING.

Electric lights are being talked at Drayton, N. D.

Sheldon, Iowa, is to have an electric light plant.

Westfield, N. Y., wants an incandescent light plant.

Spring Valley, Ill., will own a municipal lighting plant.

An electric light plant will be established at Yuma, Ariz.

Pueblo, Colo., will advertise for bids for street lighting for five years.

There is talk of bonding Whitman, Mass., for $60,000 for the purpose of electric lighting.

A local company has been granted a franchise for an electric light plant at Iowa Falls, Ia.

Kent, Wash., has voted to issue bonds for $23,500 for water-works and electric light plant.

The city council of Petersburgh, Pa., has voted to own and operate its own electric light plant.

The committee on lights at Lebanon, Pa., report that a plant can be constructed for $20,000.

Bids are asked until August 1st, for lighting the streets of Montgomery, Ala., by electricity.

It is reported that an electric light plant will be established by T. S. Walker, at Gonzales, Texas.

The citizens of Sharpsburgh, Pa., have voted in favor of an electric light plant to cost about $15,000.

Thirty thousand dollars is to be spent in enlarging the electric light plant at Glenwood Springs, Colo.

Kelso & Beaton have been granted a franchise at Hallock, Minn., and will put in an electric light plant at once.

At Hempfield, N. Y., the present contract for electric lights will expire in August, and it is said the committee will ask for bids from other companies before making a new contract.

The towns of Highland Falls, N. Y., and Georgetown, S. C., are considering the advisability of introducing electric lights.

Another boiler and dynamos double the capacity of the present one will be put in by the Fort Edward Electric Light Company at Fort Edward, N. Y.

A charter has been granted to the Lewisburgh Light, Heat and Power Company at Lewisburg, Pa., with a capital stock of $12,000.

The Pawtucket Electric Light Company, of Pawtucket, R. I., will soon extend its system of electric lights to the villages of Ashton and Berkley.

SEALED PROPOSALS.

PAVING.

OFFICE OF THE CITY CLERK,
MARIETTA, O., June 29, 1892.

Sealed proposals will be received by the city council of the City of Marietta, Ohio, at the office of the city clerk until 12 o'clock M. of Saturday, July 30, 1892, for furnishing the necessary labor and materials for the improvement of Putnam street in the city of Marietta, Ohio, from the easterly line of Second street to the westerly line of Front street, by excavating, grading, preparing foundations, and paving with brick said roadway, constructing a curb on each side of the roadway, in accordance with the plans, profiles and specifications relating to said improvement, on file in the office of the clerk of said city.

Each bid must be accompanied by a certified check for $500, payable to the order of the city clerk, as a guaranty that if the bid is accepted, a contract will be entered into and the performance of it properly secured.

Bidders are required to use the printed forms, which will be furnished on application.

Council reserves the right to reject any and all bids.

By order of the city council.

L. MUELLER, City Clerk.

PAVING.

OFFICE OF THE CITY CLERK,
MARIETTA, OHIO, June 29, 1892.

Sealed proposals will be received by the city council of the city of Marietta, Ohio, at the office of the city clerk, until 12 o'clock M. of Saturday, July 30, 1892, for furnishing the necessary labor and materials for the improvement of Greene street, in the city of Marietta, Ohio, from the easterly line of Second street to the westerly line of Front street, by excavating, grading, preparing foundations, constructing a curb on each side of the roadway, and paving with brick said roadway, in accordance with the plans, profiles and specifications relating to said improvement, on file in the office of the clerk of said city.

Each bid must be accompanied by a certified check for $500, payable to the order of the city clerk, as a guaranty that if the bid is accepted, a contract will be entered into and the performance of it properly secured.

Bidders are required to use the printed forms, which will be furnished on application.

Council reserves the right to reject any and all bids.

By order of the city council.

L. MUELLER, City Clerk.

PAVING.

OFFICE OF THE CITY CLERK,
MARIETTA, OHIO, June 29, 1892.

Sealed proposals will be received by the city council of the city of Marietta, Ohio, at the office of the city clerk, until 12 o'clock M. of Saturday, July 30, 1892, for furnishing the necessary labor and materials for the improvement of Front street, in the city of Marietta, Ohio, from the southerly line of Putnam street to the northerly line of Greene street, by excavating, grading, preparing foundations, constructing a curb on each side of the roadway, and paving with brick said roadway, in accordance with the plans, profiles and specifications relating to said improvement, on file in the office of the clerk of said city.

Each bid must be accompanied by a certified check for $500, payable to the order of the city clerk, as a guaranty that if the bid is accepted a contract will be entered into and the performance of it properly secured.

Bidders are required to use the printed forms, which will be furnished on application.

Council reserves the right to reject any and all bids.

By order of the city council.

L. MUELLER, City Clerk.

PAVING.

Sealed bids will be received at the office of the City Clerk, for thirty days, for the paving, curbing and grading of three blocks on Western Avenue and West First. For specifications and further information, apply to CHAS. HOGUE,

Dated at Mattoon, Ill., June 22, '92. *City Clerk.*

To New York via Washington.

One of the most delightful routes between Chicago, St. Louis, Cincinnati in the West and the chief cities of the East is over the Baltimore & Ohio R. R. to New York, by the way of Washington. The trip possesses many peculiar charms, especially to one whose journeyings have never taken him to the borders of the sunny Southland. The ride through the Monongahela Valley, over the Alleghany mountains, and then along the historic Potomac, awakens a keen interest in the lover of the picturesque. Much of the ground traversed has unique historic associations. A large part of this region was debatable land during the civil war. Across these fields and down these dusty roads once marched now the Blue and now the Gray. These valleys once rang with cheers, now for the Stars and Stripes, and now for the Stars and Bars. These mountainous heights more than once echoed the sounds of deadly conflict. Here General Lee invaded Maryland and Pennsylvania only to be repulsed at Gettysburg. Here Stonewall Jackson directed his forces on that "grand hunting excursion," by which he corralled the Federal forces in Harper's Ferry. And here at Harper's Ferry was John Brown's old brick fort. To one who remembers when these names were first written in blood, what an excitement of feeling their mention arouses, as do also the names, Antietam, Sharpsburg, South Mountain, Shenandoah, Harper's Ferry, Ball's Bluff.

Soon after Harper's Ferry is passed there is seen dimly the white marble shaft of Washington's Monument, and then a great white dome, and then other pinnacles and spires, and Washington is reached.

Even the most cursory glance at the city is sure to be profoundly impressive. A half hour's drive through the streets will reveal those features which have given the city its reputation and made it, in one sense, the Mecca of all patriotic citizens of this country.

New York is about five hours' ride from Washington, via the famous Royal Blue Line. The road touches at Baltimore, Wilmington and Philadelphia. This is one of the finest sections of railroad in the world, the speed of the trains often over sixty miles an hour.—*Northwestern Congregationalist.*

THE NATIONAL CAPITAL.

The City of Washington is an object of perennial interest to all patriotic Americans. Not alone because it is the great throbbing heart of the mightiest and grandest Republic the earth has ever known, but also on account of its material magnificence. All Americans take pride in its beautiful avenues, majestic architecture, stately homes, and well stored galleries and museums as things of grandeur and beauty in themselves, apart from the historic interest with which they are invested. It is a hope and aspiration of all "YOUNG AMERICA," at least, to some time or other visit the Capital of his country.

The Baltimore and Ohio R. R. offers unequaled facilities in aid of this desire. All its through trains between New York, Philadelphia and Baltimore on the east, and Pittsburg, Cincinnati, St. Louis and Chicago on the west, pass through Washington. Its fast Express trains are vestibuled from end to end and heated with steam. Pullman's latest and best productions in the way of sumptuous Drawing Room Sleeping Cars are attached to all its through trains. The present management of the B. & O. have made vast improvements in the last two years, and the road is to-day one of the foremost passenger carrying lines in the country. Through tickets via B. & O. R. R. can be procured at all the principal ticket offices throughout the United States.

GRAND EXCURSION

—TO—

NIAGARA FALLS

—VIA—

BIG FOUR ROUTE

Lake Shore and New York Central Rys.

TUESDAY, JULY 26TH, 1892

ONLY $5.00 ROUND TRIP

From Indianapolis. Only $1 more to Toronto, only $5 more to Thousand Islands.

Correspondingly low rates TO PUT-IN-BAY and LAKE CHAUTAUQUA.

Special trains will leave Indianapolis at 3:05 p. m. and 7 p. m., Tuesday, July 26, and reach the Falls at 7 and 9 the next morning. Passengers for Toronto can leave the Falls at 9:53 a. m. and reach Toronto at 1:15 p. m. Those for the Thousand Islands can leave the Falls at 8:20 p. m. and reach Alexandria Bay at 7:40 the next morning.

This will be one of the grandest, best and cheapest excursions ever run, and will be handled on special trains of palace sleeping cars, parlor cars, reclining chair cars and elegant coaches, through to Niagara Falls without change.

Don't miss it! Quick Time. Low Rates. Early arrival at the Falls. Make your arrangements in advance to go via the Big Four Route.

For full information call on

H. M. BRONSON, A. G. P. Agent.

Ripans Tabules cure biliousness.

YOU WILL MAKE NO MISTAKE

IF YOU CONTEMPLATE A TRIP TO

Chicago, Milwaukee, St. Paul, Minneapolis or any Northwestern Point,

By purchasing your tickets over the

MONON * ROUTE

L. N. A. & C. R'Y.

The New Management having entirely rebuilt the line, putting in over 300,000 new ties, miles of new steel, new iron bridges, etc., etc. This, in connection with elegant **Pullman Perfected Safety Vestibule Trains,** composed of DAY COACHES, PARLOR and DINING CARS (the only line running Dining Cars between Indianapolis and Chicago), and Pullman Buffett Sleepers, makes this

THE LINE between Indianapolis and Chicago, also the Short Line, only 183 Miles Indianapolis to Chicago.

Be sure and purchase your tickets via the

GREAT MONON ROUTE.

Ticket Offices, 26 South Illinois Street, Massachusetts Avenue and Union Station.

JAMES BARKER, G. P. A., Chicago. I. D BALDWIN, D. P. A., Indianapolis.

FINEST OF THE SEASON

GRAND ANNUAL EXCURSION

—TO—

$5 Niagara Falls, $5

$6 TORONTO, $6

$10 THOUSAND ISLANDS, $10

THURSDAY, AUGUST 11

—VIA—

C. H. & D. R. R.

By way of **DETROIT** and **MICHIGAN CENTRAL R. R.**

USUAL SIDE TRIPS TO PUT-IN-BAY.

The C. H. & D. R. R. has made the Niagara Falls excursions a specialty of the Summer season, affording thousands an opportunity of spending a pleasant vacation at a nominal expense, as all those can testify who have patronized us in former years. No expense or effort is spared to make these excursions a source of pleasure to all that go.

Arrangements have been made at the Falls for reduced rates at the hotels and places of

INTEREST AND AMUSEMENT.

Make your arrangements for **SLEEPING** and **CHAIR CAR SPACE** immediately.

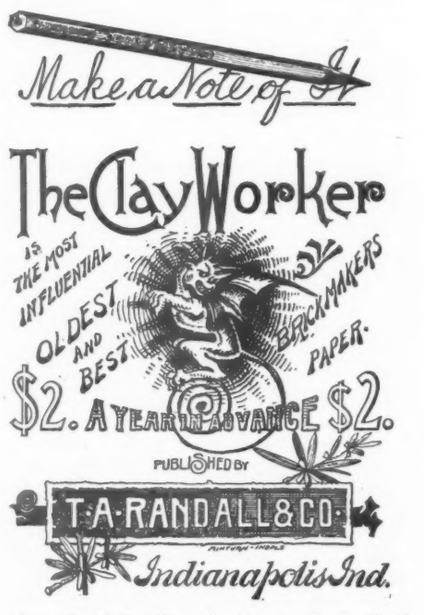
The entire train of Baggage Car, Smoker, Ladies' Coaches. Parlor and Sleeping Cars will run through to Niagara Falls without change.

H. J. RHEIN, Gen'l Agt., Indianapolis, Ind.

WE PAY CASH

For the June, August, September and October, 1890, and October and November, 1891, numbers of Paving and Municipal Engineering. Drop a card when you send them.

Paving and Municipal Engineering.



* * Send for Sample Copy. * * * *

ALSO PUBLISHERS OF

Tables of Analyses of Clay—A. Crossley. Cloth, $1.00.
Brickmaking and Burning—J. W. Crary. Cloth, $2.50.
Brickmakers Manual—R. B. Morrison. Cloth, $3.00.
Sent postage free on receipt of price.

THE PURINGTON-PAVING BRICK COMPANY

OF GALESBURG, ILLINOIS,

Is now building one of the most extensive and best equipped plants ever established for the manufacture of Paving Brick. D. V. Purington, of Chicago, is President of the Company. Mr. Purington is one of the foremost Brick Makers in the country. With a quarter of a century experience he has a thorough knowledge of the merits of the various DRYERS. HE HAS SELECTED FOR HIS NEW WORKS

* * * THE IRON-CLAD DRYER * * *

This Dryer will have a Drying Capacity of SEVENTY-FIVE THOUSAND per day. Mr. Purington's selection is another evidence of the established fact that for

PAVING BRICK NO OTHER DRYER COMPARES

WITH THE IRON-CLAD DRYER

For particulars see advertisement on last page of cover, and write to

358 Dearborn Street Room 304 — Iron Clad Dryer Co. — Chicago Ill

WORKS; DEARBORN, HARRISON AND 3D AVENUE.

New Discovery
DOWN DRAFT KILN

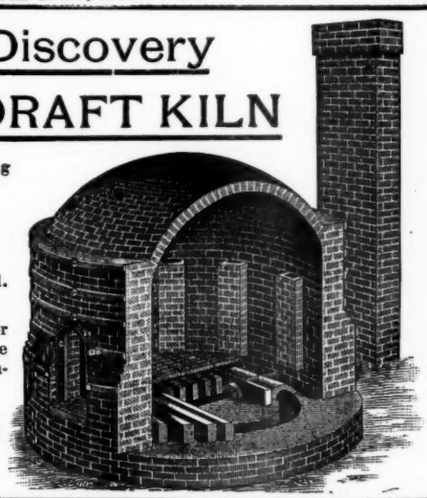
For uniformity of Burning and Economy of Fuel it is

Not Equaled.

Not Expensive to Build. Easily Kept in Repair.

Those interested, write for many testimonials from the leading plants of the country. Address,

E. M. PIKE & CASTLE,
CHENOA, ILL.



FUEL GAS

Adapted to every kind of kiln, from the AMATEUR CHINA DECORATORS' KILN to the mammoth BRICK KILN, and to every kind of METALLURGICAL FURNACE. Unlimited TEMPERATURE with minimum of FUEL.

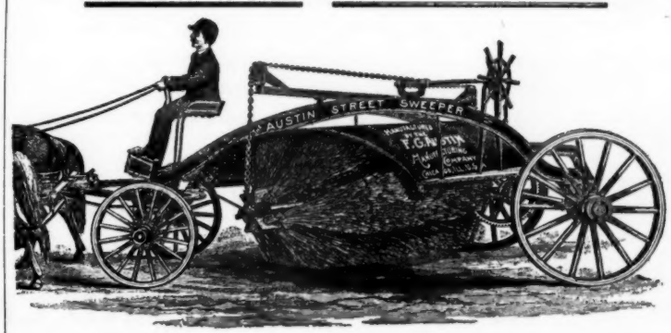
Send stamps for pamphlet. PRODUCER *versus* NATURAL GAS.

W. WAPLINGTON, 5420 Vine St., Philadelphia, Pa.

The ease of cycling is in the
TIRE

About the Columbia Pneumatic Tire—It wears—Tested to 200 pounds above riding pressure—A compound tube of rubbers vulcanized with canvas layers—Each part strengthening the others—Greatest resistance to puncture—Most resilient road tire—Freedom from lacing, wrapping, and other objectionable points—The highest grade tire of scientific simplicity—Absolutely guaranteed for a year—All about it and Columbia's cycles in our book about Columbias, free on application to any Columbia agent, or sent by mail for two two-cent stamps—Pope Mfg. Co., 221 Columbus Ave., Boston.

STREET SWEEPER



Streets 28 feet wide between curbs are cleaned in two rounds.
Operated by driver and two horses. For particulars, address

F. C. AUSTIN MANUFACTURING CO., CHICAGO, ILL.

H. H. WAINWRIGHT,
PATENTEE.

The Anchor Artificial Curb

IRON BOUND AND
NON-BREAKABLE.

PATENTED MAY 20, 1890.

ESPECIALLY ADAPTED FOR STREETS, WHARVES, RAILROAD DEPOTS, PIERS, ROADWAYS OF BRIDGES, MARKET HOUSES, BREWERIES, WAREHOUSES, ETC., ETC.

THE INVENTOR of the Anchor Iron Bound Curb has been for several years engaged in the business of laying Artificial Stone Pavements, and has put down large quantities of Cement Curbing, as at present used. THIS HAS ONE SERIOUS DEFECT, viz.: The liability to break or chip off at the outside edge or corner, from the impact of wheels of vehicles of all kinds trucks, coal carts, milk or express wagons; even wheelbarrows or bakers' carts will chip off pieces when rudely pushed against this edge, and destroy its symmetry.

The effort to overcome this objection has resulted in the present patented improvement, which is designated

THE ANCHOR ARTIFICIAL CURB.

ITS ADVANTAGES ARE

Greatly reduced cost as compared with Granite Curbing, which it will, in time, entirely supplant, as it is superior in appearance and finish.

It is provided on the outside edge with an iron plate, which strengthens as well as protects it from wear, and breaking from contact with cart or wagon wheels, or other causes of injury. This plate, being galvanized, does not discolor the face of the curb.

In addition to this, two bars of angle iron form the front and back of the bottom of the curb, making it **Iron Bound** on THREE corners, and tie rods are imbedded in the concrete for its entire length, giving it strength equal to granite, and making it absolutely **non-breakable.**

This curb is continuous throughout its entire length, and has no joints to separate and get out of position, as the short lengths now used of the ordinary stone invariably do, after a few years of use.

Although lighter, and containing less material than the heavy stones now used, it has a strong iron frame, resting on foundation pieces, which are buried deeper than the curbstones now in use, and provided with **Anchor Plates,** which make it immovable under any circumstances.

While it is an ornamental improvement to private dwellings, it is of great value in such places as the yards of breweries, and the vicinity of market-houses, warehouses, etc., where heavy wagons are continually backing up to receive or discharge their loads.

For railroad depots, wharves, piers and shipping docks, also driveways for bridges, it will prove of great benefit, and will outlast any other kind of Curbing that could be used.

The COMMERCIAL VALUE of the Anchor Iron-Bound Curb is in the fact that it can be laid at a much lower cost than Granite curbing and pay a profit of about 50 per cent.

It is superior in finish and appearance to Granite or Blue-stone, and fully its equal in strength. It has been laid for some months in Washington, and subjected almost daily to severe tests, and fully justifies all representations made regarding it.

The company adopting it in Washington is one of the oldest and best known in the United States, and companies in Baltimore and Philadelphia and other places are now being formed to adopt it in connection with other branches of the Paving business.

Address, for other information,

H. H. WAINWRIGHT, Contractor.

Room 10, Washington Loan and Trust Company Building, Washington, D. C.

STATE RIGHT AND LICENSES FOR SALE.

PROFESSIONAL CARDS.

The many letters constantly received asking for the names of persons who can give technical advice on municipal work must be answered by the publishers, by referring the writers to this list of competent and reliable Civil Engineers.

ANDREW ROSEWATER, C. E.,
M. AM. SOC. C. E.,
Engineer Municipal Public Works
SEWERAGE A SPECIALTY.
424 BEE BUILDING, OMAHA, NEB.

THOS. R. HASLEY,
CIVIL ENGINEER
Surveys, Plans and Specifications for Sewerage and Drainage, Special Attention paid to Paving and General City Improvement. Expert City Surveying, Detail City Maps, Grade Atlases, Construction Superintended.
Main Office at Marinette, Wisconsin.

HIRAM PHILLPS, C. E.
CONSULTING
CIVIL AND MINING ENGINEER,
810 Olive Street, St. Louis, Mo.
Extended experience in testing all kinds of paving materials, plans, estimates and specifications.

ARTHUR H. BELL,
CIVIL ENGINEER
BLOOMINGTON, ILLINOIS.
Extensive experience in Brick Paving and Sewerage Work. Surveys, Plans and Specifications and Estimates Furnished.

SAMUEL M. GRAY,
Consulting Engineer
For Municipal and Sanitary Work.
26 Westminster St., Providence, R. I.

GEO. PAUL, C. E.
Formerly Member Board of Public Works of Ohio
432 Society for Savings Building,
CLEVELAND, OHIO.
SEWERAGE, WATER SUPPLY, MILL DAMS AND OTHER HYDRAULIC IMPROVEMENTS.

S. H. SHEARER,
CIVIL ENGINEER,
Bridges, Sewers, Pavements.
33 Ingalls Block, Indianapolis, Ind.

E. F. LAYMAN,
Civil and Sanitary Engineer,
Rooms 17-18, 64 W. 3d St., Cincinnati, O.
Surveys, Plans and Specifications for Sewerage, Drainage and Water Supply. Special attention paid to Pavements and general city and village improvements; also Surveying of city and suburban property.

RIPANS TABULES regulate the stomach, liver and bowels, and purify the blood; are safe and effectual; the best medicine known for indigestion, biliousness, headache, constipation, dyspepsia, chronic liver troubles, dysentery, bad complexion, dizziness, offensive breath and all disorders of the stomach, liver and bowels. One tabule gives immediate relief. Take one at meal time. Sold by Druggists. A trial bottle sent by mail on receipt of 15 cents
RIPANS CHEMICAL CO., 10 Spruce St., New York.

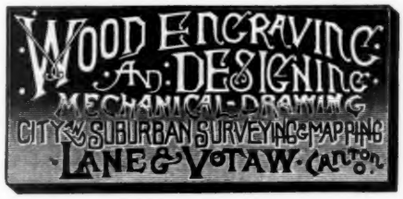
PROFESSIONAL CARDS.

J. A. STEWART,
EX-CHIEF ENGINEER,
Cincinnati, Ohio,
35 Johnston Building, S. W. cor. 5th and Walnut Sts.
CIVIL ENGINEER.
Surveys and Plans for Sewerage Systems and Street Paving. Railway Surveys. Public Works Superintended.

LATHAM ANDERSON,
M. AM. SOC. C. E.
Consulting Engineer,
Rooms 49 & 54 Johnston Buildings,
Cincinnati, Ohio.
Sewerage, Water Supply, Municipal Engineering, Landscape Engineering, Construction Superintended.

WILLIAMSON & EARL
Civil and Sanitary Engineers.
Plans and Estimates made for Water Supply, Sewerage, Bridges and General Engineering Work, Railroad Surveys and Construction. Construction Superintended. Sewerage a Specialty.
MONTGOMERY, ALA.

Jas. D. & Miles S. Saunders
CIVIL ENGINEERS AND SURVEYORS
EVANSVILLE, IND.
Surveys, Plans and Specifications on Sewers, Streets and other Municipal Work.
Estimates and Reports on all such work for cities and towns given prompt attention.



BALTIMORE & OHIO
Southwestern R. R.
SAVED TO
$2 New York and Boston
ALL TRAINS RUN THROUGH
Washington, Baltimore and Philadelphia.
"BEST IN THE WORLD."
The B. & O. Southwestern limited, an entirely new train, Vestibuled, lighted with Pintsch Gas, and has the Anti-Telescopic device, leaves Cincinnati every evening and the New York Express every morning.

THE SHORTEST AND BEST EQUIPPED LINE BETWEEN
CINCINNATI and COLUMBUS
Pullman Parlor and Sleeping Cars,
Time 3¼ hours.
TWO SOLID TRAINS TO **PITTSBURGH**
Via Columbus, Zanesville and Wheeling.
With Pullman Buffet Sleeper and Parlor Cars.

Rates always as low as by any other line, and no extra fare for fast time on limited vestibuled trains.
Ask for tickets via Cincinnati and the B. & O. R. R.
W. W. PEABODY, Vice-President. O. P. McCARTY, Gen'l Pass. Agt.

PROFESSIONAL CARDS.

M. AM. SOC. C. E. M. AM. SOC. M. E.
OLIN H. LANDRETH,
NASHVILLE, TENN.
Consulting Engineer.
Water-works, water power, drainage, reclamation, improvement of highways and street paving.
Examinations, expert tests, reports, designs, specifications and estimates.

ARTHUR S. HOBBY,
Civil and Sanitary Engineer
No. 227 Main Street,
Cincinnati, Ohio.
Sewerage Systems for Cities and Villages designed and their construction superintended.
Design and construction of manufactories.
Foundations for heavy buildings, and for engines and machinery.
Foundations in bad ground or in water.

V. H. LOCKWOOD
Patents
SOLICITOR AND COUNSEL
(Successor to CHAS. P. JACOBS)
60 EAST MARKET STREET, INDIANAPOLIS.

BRICK PAVEMENTS
—BY—
C. P. CHASE, Civil Engineer, Clinton, Iowa.
Full instructions from the beginning, with complete specifications.
The most useful and reliable hand book to be obtained. Price, $1.00.

Pittsburgh Testing Laboratory,
116 Water Street,
PITTSBURGH, PA.
SPECIALTIES—Chemical tests of all kinds; inspection of water pipe; testing of brick and paving materials; inspection of structural material.

WANTED—Purchaser or renter for Tile Plant Fine Clays for Pavers or Hollow Blocks. Call at or address P., Room 6 Yohn Blk., Indianapolis.

FOR SALE—One Centennial and one Old Reliable Brick Machine. F. L. WILLIAMS, Woodland, Ill.

ARTIFICIAL STONE

Manufacturers and Pavement Makers, take Notice that

"DIAMOND BRAND"

GIBBS' G CEMENT

PORTLAND.

IS THE VERY BEST MATERIAL FOR ALL PURPOSES ON ACCOUNT OF ABSOLUTE UNIFORMITY AND GREAT STRENGTH.

Testimonial

We have regularly used your Cement for over ten years, and have been so satisfied with the result of work done with it that we are this year placing with you the contract (30,000 barrels) for the whole of our requirements both at Stratford and Groby.

LONDON, January 9, 1891. Yours faithfully, THE PATENT VICTORIA STONE CO., L'D.

To Messrs. Gibbs & Co., L'd. HARRY ROGERS, Manager and Sec'y.

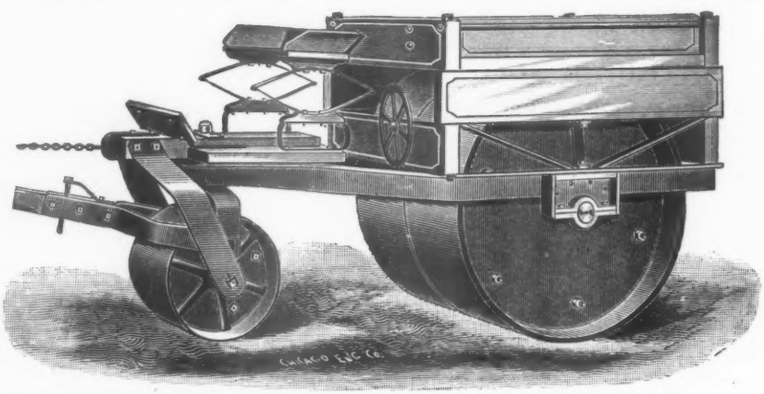
Write for prices and all information to **HOWARD FLEMING, 23 Liberty St., New York, Sole Agent in the United States.**

IF YOU KNOW

Any person interested in anything that comes within the scope of this journal, who is not now a subscriber, we would like to have his name and address

WE CAN HELP HIM

ROLLER FOR STREET PAVING



FOR CATALOGUE AND PRICE ADDRESS ENTERPRISE MFG. CO. 103 MAIN ST. COLUMBIANA, O.

FOR MAKING ROAD METAL USE THE

GATES ROCK AND ORE BREAKER

OVER **2000** IN USE.

CAPACITY IN TONS OF 2,000 POUNDS.

Size 0	2 to 4 tons per hour.	Size 4	15 to 30 tons per hour.
Size 1	4 to 8 tons per hour.	Size 5	25 to 40 tons per hour.
Size 2	6 to 12 tons per hour.	Size 6	30 to 60 tons per hour.
Size 3	10 to 20 tons per hour.	Size 7	40 to 75 tons per hour.
		Size 8	100 to 150 tons per hour.

Passing 2 1-2 in. ring, according to character and hardness of metal.

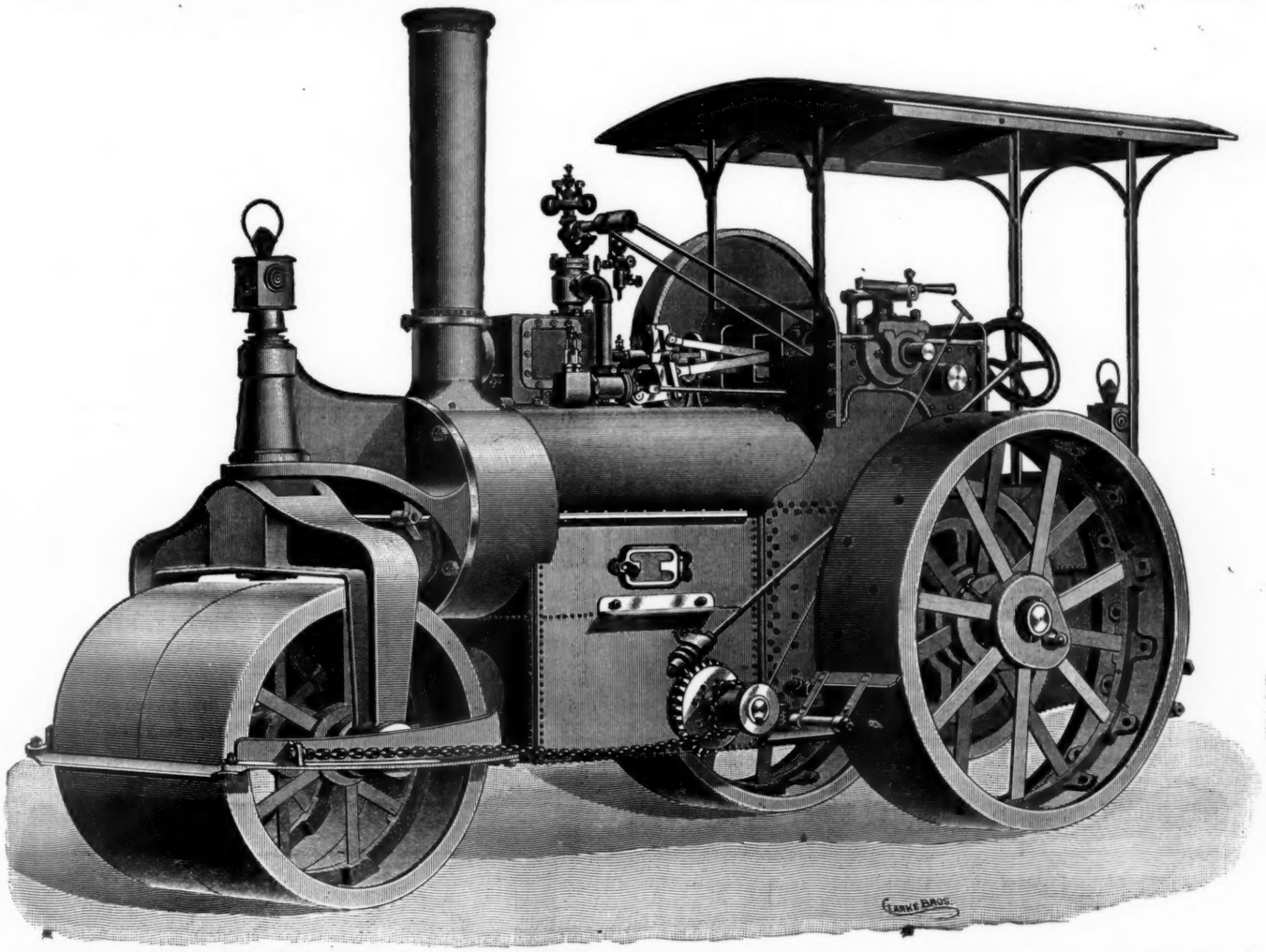
Great Saving in Power. Adjustable to any Degree of Fineness. The principle involved in this Breaker acknowledged to be the greatest success ever introduced into Stonebreaking machinery. The Gates Breaker has made more railroad ballast and road metal than all other kinds of breakers combined. **Universally Adopted by Mining Companies. Many Hundreds Used by Railway Companies.** Will furnish a thousand references from Contractors, Street Superintendents, Mines, Cement Manufacturers, etc. Also Manufacture

THE CORNISH ROLLS PULVERIZER

Fine Crushing Plants, Concentrators and Other Mining Machinery. Address for Catalogue

78a Queen Victoria St., LONDON.
44 Dey St., NEW YORK.
215 Franklin St., BOSTON, MASS.

Gates Iron Works, 50R S. Clinton St., Chicago.



SPRINGFIELD STEAM ROAD ROLLERS.

THREE SIZES: 10 TON, 12½ TON, 15 TON.

GUARANTEED TO GIVE SATISFACTION.

PORTABLE TAR HEATING TANKS AND STREET CONTRACTORS' SUPPLIES.

ADDRESS THE O. S. KELLY CO., Springfield, O.

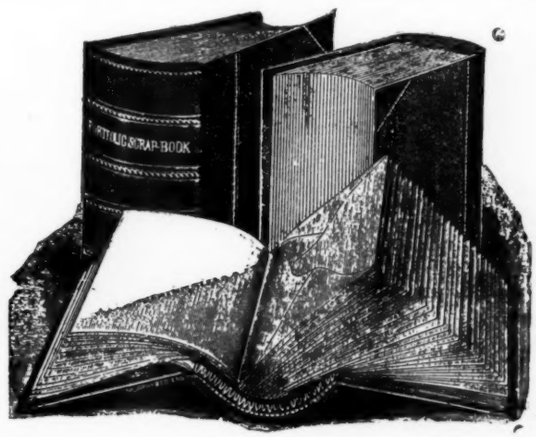
* * BREED'S * *

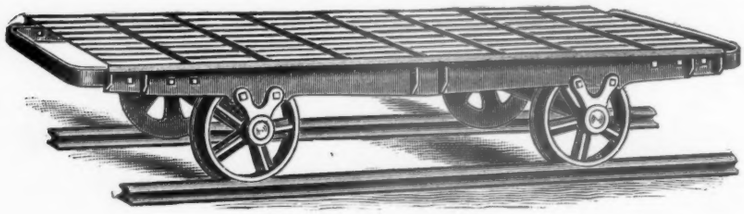
Patent Portfolio Scrap-Book

A SCRAP-BOOK WITHOUT PASTE.

The old-fashioned Scrap-book has leaves on which scraps are pasted, as collected, without orderly arrangement. Breed's Scrap-Book has pockets, or envelopes, into which scraps are dropped and methodically filed by subjects. There is no pasting, no annoyance, no loss of time, no dirt! The subject is written on the envelope containing it and entered in the index. No matter how many scraps have accumulated, all upon the same subject are together and can be easily removed, consulted and replaced. Scraps kept in this book are not blurred by pasting, defaced by exposure or mutilated by removal. Notes for editorials, sermons, lectures and other addresses can be filed here, and a record of time and place of delivery be written on the envelope. As a receptable for scraps, papers and writings, *methodically arranged for convenient reference*, it has no equal. It contains fifty heavy manila envelopes, with tuck, 6x9 inches in size, handsomely bound together in a book that stands upon an ordinary book-shelf. Half Amer. Russia, cloth sides. Price, post-paid, $3 net.

THE BOWEN-MERRILL CO., INDIANAPOLIS, IND.





STYLE 18. FOR PAVING BRICK.

BRICK CARS 48 STYLES.
ALSO **KILN DOORS AND GRATE BARS**

BUY THE BEST.

BE SURE To have your Dryer equipped with our Cars. It will save you time, trouble and money. We manufacture a line of Cars for carrying all sorts of Brick and Tile. They are all iron, incomparably strong, easy running and low in price. It will be greatly to your advantage to trade with us. Send for catalogue.

THE WALWORTH RUN FOUNDRY COMPANY, CLEVELAND, OHIO.

THE BEST AND CHEAPEST

Interstitial Filling for any kind of Block Paving,
Stone, Brick, Wood or Cobblestone, is

Murphy's Grout Filling

It has been in Use in Columbus, Ohio, for Six Years,

Under the heaviest traffic, without any signs of wear being perceptible. It has been adopted for use hereafter in all block paving.

A secret of success in Block or Brick Paving is the use of interstitial filling that will wear without breaking. Mr. Murphy has discovered the secret. His Grout Filling makes the most durable pavements, as experience with it demonstrates. It is not only infinitely better than coal-tar, but it is forty per cent. cheaper in cost. For full information address

JOHN MURPHY, Patentee, 58 Board of Trade Building, Columbus, Ohio.

WE MANUFACTURE

Brick and Tile Yard Supplies

OF ALL KINDS

If needing anything in this line, please correspond.
Illustrated Catalogue Free.

D. J. C. ARNOLD, New London, O.

THE HARRISBURG PATENT

• • DOUBLE ENGINE STEEL • •

Steam Road Roller

Constructed of the Best Quality of Material Throughout Guaranteed Equal to any

ROLLER IN THE MARKET.

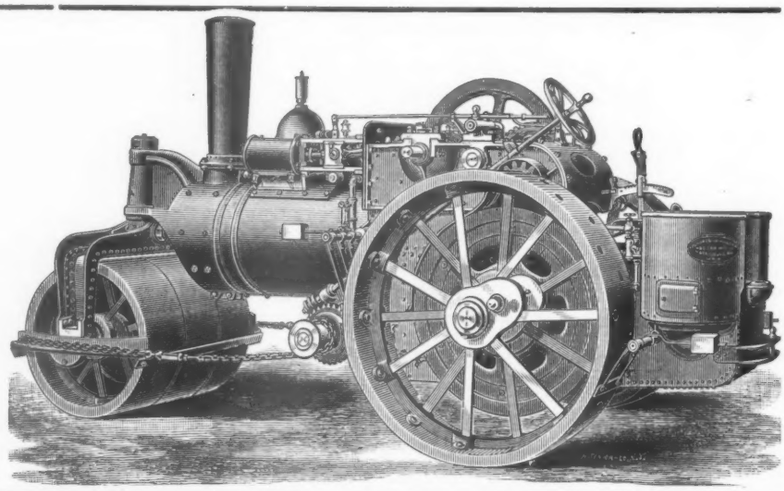
MANUFACTURED BY

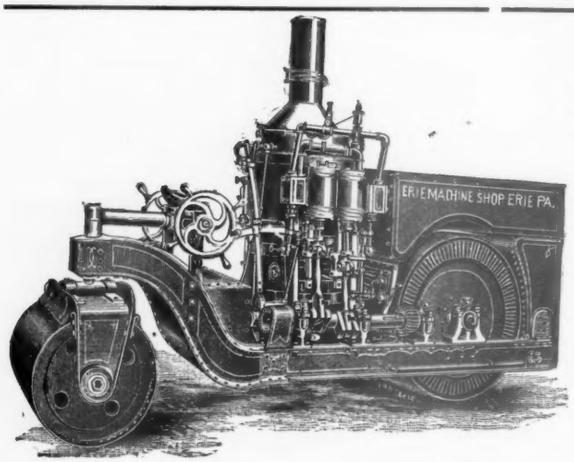
HARRISBURG FOUNDRY AND MACHINE WORKS,

Successors to Foundry and Machine Dept. of the Harrisburg Car Mfg. Co.,

HARRISBURG, PA.

SEND FOR CATALOGUE.





ERIE MACHINE SHOP,

MANUFACTURERS OF

Steam Rollers

Corner Twelfth and State Streets,

ERIE, PA.

The principal Asphalt Paving Companies in the country are using these machines, which are pronounced to be the best in the market.

The Indianapolis Paving Exposition

Embracing the Largest and Finest Collection of Specimens of Paving in the World, will, on account of its value and beneficial influence in stimulating a spirit of public improvement, be continued indefinitely under the management of the Commercial Club of Indianapolis, the organization which originated the idea and made the Exposition a success. **Exhibits of more than sixty of the Leading American Paving Companies.** New exhibits are being added, and the Exposition will be enlarged and improved in every way possible. Companies not already represented are invited to send exhibits, but no paving material regarded by the committee in charge as being without merit will be admitted to the Exposition. Exhibits must, in all cases, be shipped with freight charges prepaid. The assurance can be given that more can be learned about paving at this Exposition than by visiting a dozen of the best paved cities in America.

ALL cities in the United States are invited to send committees or official delegations to Indianapolis to avail themselves of the unequaled advantages afforded by the Exposition for GATHERING KNOWLEDGE OF PAVING. ◆ ◆ ◆ ◆ ◆ ◆

A TWO-CENT STAMP SHOULD BE SENT with requests for COPIES OF THE REPORT OF THE PAVING EXPOSITION.

FOR FURTHER INFORMATION, ADDRESS THE COMMERCIAL CLUB, INDIANAPOLIS, INDIANA.

M. S. HUEY, GEO. N. CATTERSON, WILLIAM C. BOBBS, Paving Exposition Committee.

Pavements and Roads

Their Construction and Maintenance.

By E. G. LOVE, Ph. D.

Large 8vo., pp. 410; handsomely bound in cloth.
Sent post-paid on receipt of $5.00.

ADDRESS PAVING AND MUNICIPAL ENGINEERING
CHAMBER OF COMMERCE, INDIANAPOLIS, IND.

Unequaled for all purposes for which Portland Cement is used. Tests and Testimonials of Engineers and a useful pamphlet sent free on application. ● ●

Buckeye Portland Cement Co. Bellefontaine, Ohio.

When you write to Advertisers, mention PAVING and MUNICIPAL ENGINEERING.

OFFICE-GETTING.

A BOOK OF HELPFUL INFORMATION ON PRACTICAL POLITICS.

EVERY CANDIDATE,
EVERY POLITICIAN,
EVERY PERSON CONTEMPLATING A POLITICAL CAREER,
EVERY MAN AND WOMAN DESIRING APPOINTMENT IN THE CIVIL SERVICE,

SHOULD HAVE IT.

IT IS PRACTICAL.
IT IS WHAT IS DESIRED BY THOSE SEEKING HELPFUL INFORMATION.

It discusses politics as a business, the essential qualifications for a political career, and gives valuable advice as to how to succeed.

It also fully and clearly explains how persons desiring to obtain positions in the civil service should proceed, explains the requirements of the different positions, the salaries of which range from $720 to $2,000 a year, and gives specimen examination questions.

It is strongly commended by the press. *The Indianapolis News* says: "The seeker after office will find here practical information, that it will be money in his pocket to know, whether he is going to be a candidate for council, something higher, or an applicant to theC ivil Service Board for office. We do not know of any other place where so good an idea of the civil service can be found as here. The author of 'OFFICE-GETTING' takes it for granted that his readers know nothing of the requirements of the civil service (a fair assumption), and on that basis tells what to do to get positions under the federal law. Specimen examination questions are given in all of the governmental departments. The quality of the book is high."

Louisville Times: "The book contains all that it ought to, and not a word too much. Throughout the style is terse, crisp and straightforward."

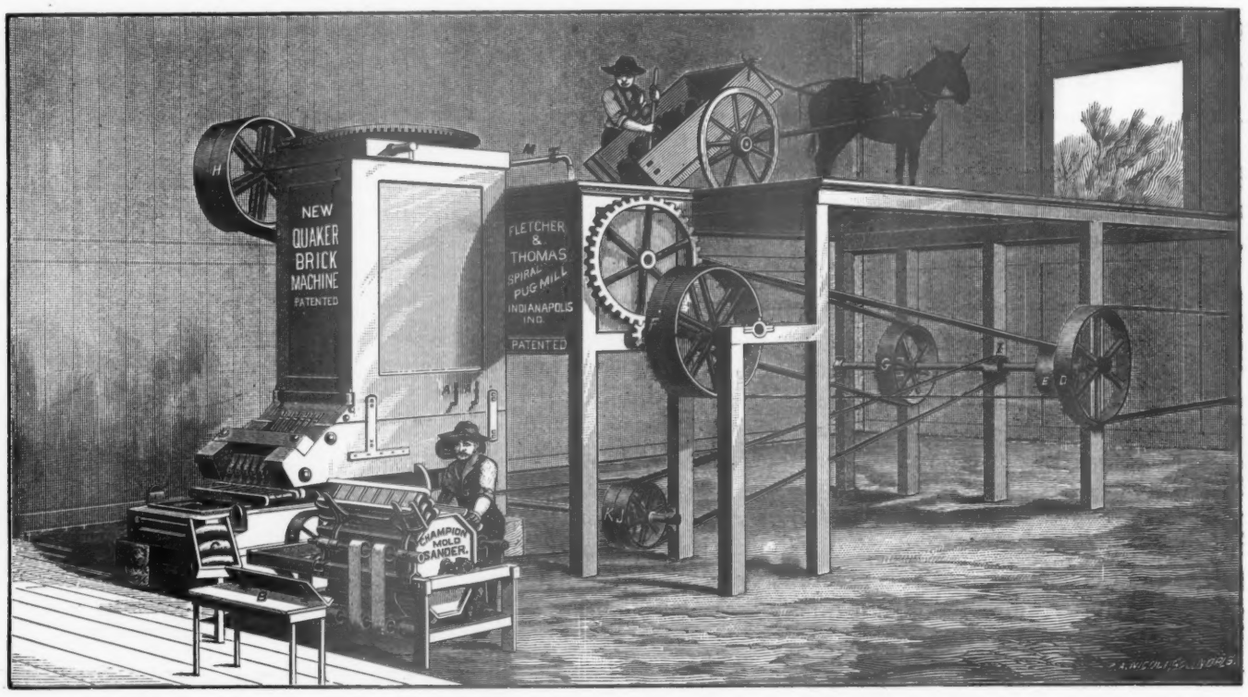
Chicago Morning News: "The questions are discussed sensibly, brightly and with apparent wide knowledge of the topic. The book will be appreciated by politicians everywhere."

Every person actively interested in politics should read it.

Bound in leatherette, artistically printed, 141 pages. **Only One Dollar per copy, postage paid.**

THE BOWEN-MERRILL COMPANY,
PUBLISHERS,
INDIANAPOLIS, IND.

FLETCHER & THOMAS



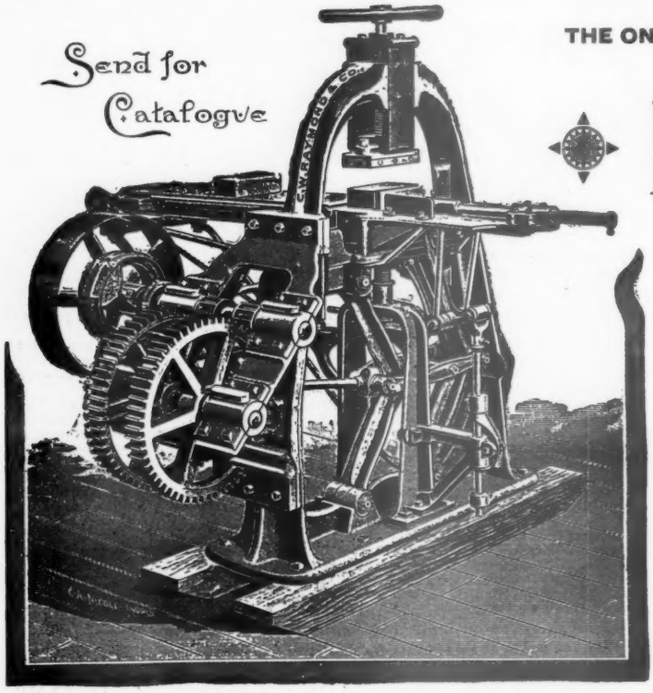
Improved Brick-Making Machinery

The above cut represents the New Quaker Complete Combined Steam Power Outfit. Capacity, 40,000 per day. Capacity of Horse-Power, 15,000 to 20,000. The most perfect machinery for making PAVING BRICKS, FIRE BRICKS or COMMON BRICKS. We make a specialty of equipping yards complete in every detail ready for work. Send for illustrated catalogue.

Correspondence Solicited. **FLETCHER & THOMAS, INDIANAPOLIS, INDIANA.**

RAYMOND'S AUTOMATIC POWER PRESS

Send for Catafogve



THE ONLY SUCCESSFUL RE-PRESS FOR MAKING

PAVING BLOCKS

RED AND FIRE BRICK, ROOFING TILE, ETC.

A rapid working and powerful machine for pressing paving blocks, by which they are given great density and uniformity of size and finish. Make from 8 to 12 thousand finished paving blocks per day. No first-class paving brick made without re-pressing.

Dumping Cars, Portable Track,
Dryer Cars, Transfer Cars
and General Brick Yard Supplies.

C. W. Raymond & Co., Dayton, Ohio.

INDIANA BRIDGE COMPANY

Wrought Iron High Truss Bridge, one Span, 210 feet, over Mississinewa River, at Sharon, Delaware County, Indiana.

MANUFACTURERS OF

Wrought Iron Bridges
Iron Sub-Structures,
Viaducts, Roofs & Buildings

Muncie, Indiana.

DIRECTORS.
C. M. KIMBROUGH, President and Gen. Mgr.
JOHN R. MARSH, Secretary and Treasurer.
A. L. JOHNSON. GEO. F. McCULLOCH. T. F. ROSE.

WE BUILD ANY KIND OF IRON BRIDGES WANTED.

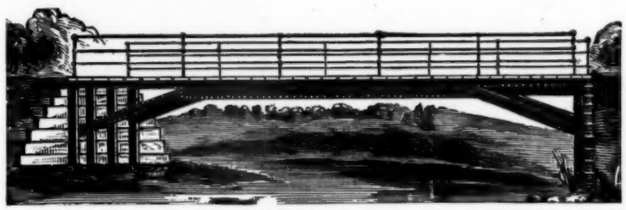
Can give satisfactory reference to larger amount and greater variety of work done in Indiana than any other Bridge Company. We are the only Company operating shops in the state. We invite inspection of our shops for efficiency and capacity.

NOTICE OF LETTINGS SOLICITED.

OVER 200 OF OUR PATENT LEG BRIDGES IN USE
IN THIS STATE.

The Best Bridge for Spans up to 70 feet. We sell only our own Manufacture. Address all communications to

Indiana Bridge Co., Muncie, Ind.



Above cut shows our Patent Leg Bridge.

GALESBURG PAVING BRICK.

The demand for these Celebrated Brick has hitherto far exceeded the supply. By the erection of one of the largest and most complete plants in the country, the PURINGTON PAVING BRICK COMPANY expects to be able to furnish these Brick in any desired quantity, and to fill all orders promptly and satisfactorily. ∴ ∴ ∴ ∴ ∴ ∴ ∴

Prices and samples furnished on application to

PURINGTON PAVING BRICK COMPANY,

First National Bank Building, Galesburg, Ill.

THE UNITED STATES FIRE CLAY CO.

MANUFACTURERS OF

PAVING BRICK

AND ALL FIRE CLAY PRODUCTS.

GENERAL OFFICES, 91 AND 93 FIFTH AVE., PITTSBURGH, PA.

NEW YORK: 145 Broadway.
TORONTO: 44 Price Street.
CHICAGO: 410 Chamber of Commerce.

WHY DOES

THE U. S. DRY CLAY BRICK PRESS

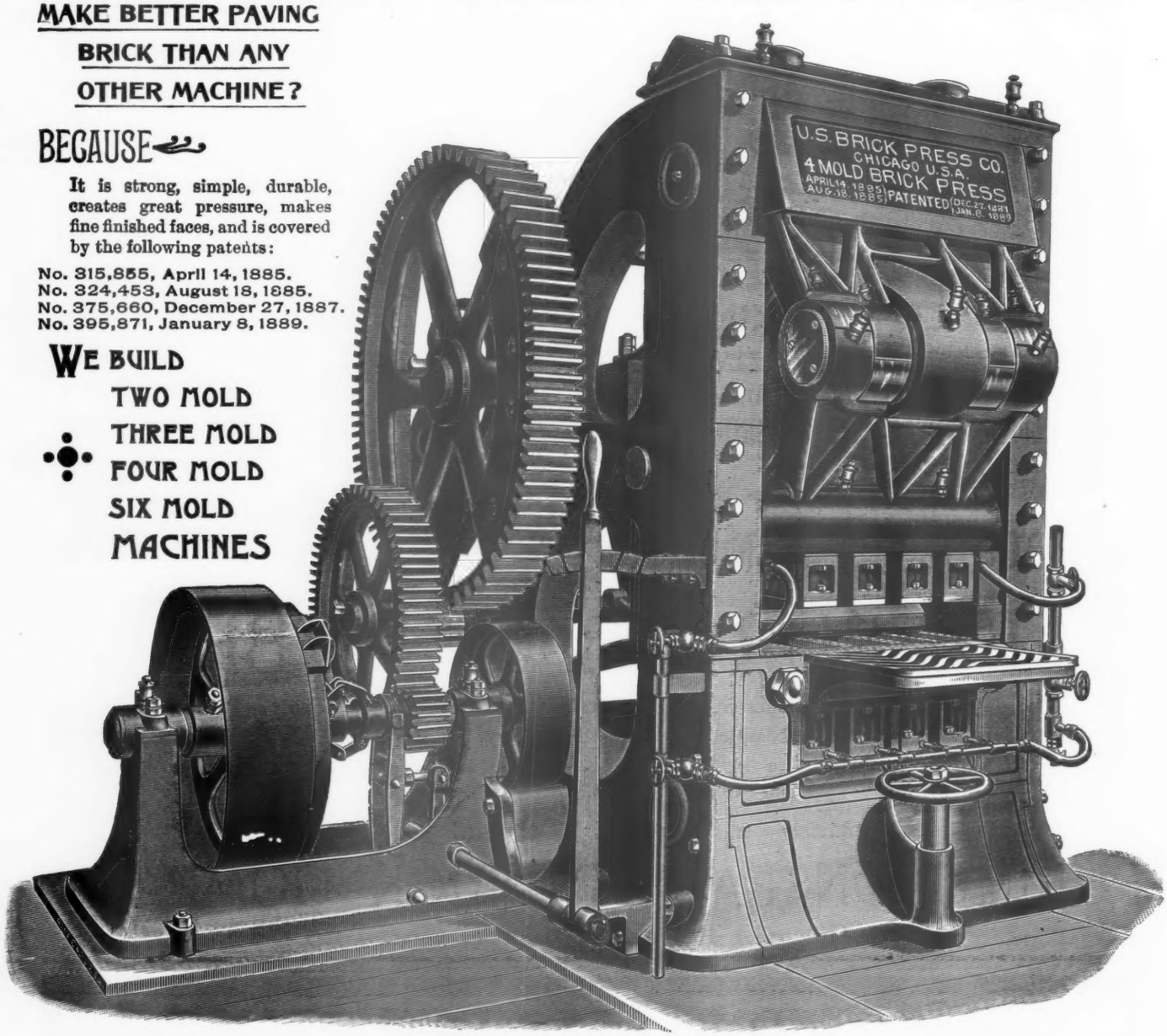
MAKE BETTER PAVING BRICK THAN ANY OTHER MACHINE?

BECAUSE

It is strong, simple, durable, creates great pressure, makes fine finished faces, and is covered by the following patents:

No. 315,855, April 14, 1885.
No. 324,453, August 18, 1885.
No. 375,660, December 27, 1887.
No. 395,871, January 8, 1889.

WE BUILD
TWO MOLD
THREE MOLD
FOUR MOLD
SIX MOLD
MACHINES



Clay sent us, freight prepaid, will receive our prompt attention, pressed and burned, and sample brick returned.

SEND FOR CATALOGUE AND PRICES TO

THE UNITED STATES BRICK PRESS COMPANY,

OSWALD KUTSCHE, PROPRIETOR.

1111 UNITY BUILDING—79 DEARBORN STREET,

CHICAGO, ILL.

Mention Paving and Municipal Engineering.

CALIFORNIA ASPHALT

THE STANDARD ASPHALT COMPANY, of Bakersfield, Kern Co., California, controlling extensive deposits of genuine asphaltum, believed to be second only to the Trinidad in extent, invite orders for high grade refined asphalt for street paving and other purposes. The supply being practically unlimited, there is no ground for fear that the large and increasing demand can not be met for many generations, notwithstanding those who control the imported article give currency to the idea that there is none in the United States. Our asphalt is fluxed, softened and refined with a natural maltha (liquid asphalt) of 10° to 14° Baumé, forming a chemical and homogeneous mixture superior to the residuums elsewhere used. We can furnish fluxing maltha with our asphalt for the manufacture of paving cement, when desired. We also manufacture the Standard Asphalt Roofing Compound, covered by U. S. and foreign letters patent, flexible, elastic and durable, confidently asserted to be superior to any asphalt pitch or tar roofing ever used. The Standard Asphalt is likewise adapted to and used for pipe covering, electric conduits, reservoir linings, varnishes, etc.

Correspondence solicited and samples mailed to any address upon application. Car load delivery quoted to any point.

STANDARD ASPHALT CO.
Bakersfield, Kern Co., Cal.

E. G. CHURCH,
General Eastern Agent,
Builders' and Traders' Exchange, Kansas City, Mo.

THE WESTERN

Paving and Supply Company

CONTRACTORS FOR

TRINIDAD ASPHALT PAVEMENTS,

THE STANDARD PAVEMENT OF AMERICA.

Over five million square yards in use in the United States.

It has, in fifteen years, raised the streets of Washington and Buffalo from the poorest to the best in the United States.

It will raise the streets of any city that uses it to the same high grade.

It is the only pavement that will do it.

It is the only perfect sanitary pavement.

It enhances the value of abutting property as much as it improves the city using it.

It is the ideal pavement of modern times.

We invite an inspection of our work.

GENERAL OFFICES, 36 LaSalle Street, CHICAGO.
INDIANAPOLIS OFFICE, 33 Ingalls' Block.
DETROIT OFFICE, Cor. Jefferson Avenue and Griswold Street.

FOR

CUBAN ASPHALT

ADDRESS

OTTO D. DROOP.

MINE OWNER,

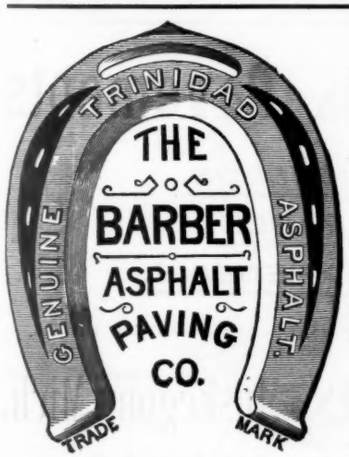
Havana, Cuba.

California Asphalt

The Oil Burning and Supply Company furnish the finest and purest grades of Refined California Asphalts for Paving, Roofing, Paints, Varnishes, Electrical Works, etc. Our Liquid Asphalt for Fluxing and Tempering is the finest article in the market. We recommend our **A G** Brand for Paving, 85 per cent. to 90 per cent. pure. Contractors and Dealers supplied in quantities to suit on short notice. Samples on application. Address

The Oil Burning and Supply Company,
8 and 9 BURDICK BLOCK, LOS ANGELES, CAL.

LAKE ASPHALT LAKE ASPHALT



THE BARBER ASPHALT PAVING CO.

USES LAKE ASPHALT ONLY.

THE OLDEST AND LARGEST Asphalt Paving Company in the United States; has laid Asphalt pavements in thirty-three cities of the Union, on 857 streets of a length of 442 miles, or an area of 5,915,000 square yards. It has laid more pavement in fourteen years than all other Asphalt Paving Co's in Europe and America Combined have laid in thirty years.

GENERAL OFFICES, NO. 1 BROADWAY, NEW YORK.

LE DROIT BUILDING, WASHINGTON, D. C.

THE NEW YORK AND BERMUDEZ CO.

having acquired by purchase the largest lake or deposit of Asphalt in the world, covering an area of over 1,000 acres, situated in State of Bermudez, Venezuela, and having expended large sums of money in perfecting shipping facilities, are now prepared to sell and deliver a refined Asphalt of over 95 per cent. purity and of a quality far superior to any other for paving, roofing, etc. It will do 50 per cent. more work than any other Asphalt. We guarantee its excellence and purity, and Prof. E. J. De Smedt, our chemist, will give scientific and expert instructions to parties using it.

NEW YORK AND BERMUDEZ CO.

25 BEAVER STREET, NEW YORK.

WE MANUFACTURE

Brick and Tile Yard Supplies OF ALL KINDS

If needing anything in this line, please correspond. Illustrated Catalogue Free.

D. J. C. ARNOLD, New London, O.

Hayden's Patent Paving Block

Has no superior, smooth as Asphaltum and durable as Granite. Our sidewalk block is beautiful and durable, it is an admirable block for Driveways, Cellars, Warehouses, Washhouses, Livery Stables, Smoke Stacks, Lining Boilers, and all similar work. Fire Proofing of All Kinds, Ground Fire Clay, Fire Brick, Fire Clay Tiles, Beveled Grate Tiles, Chimney Tops, Flue Linings, Vitrified Wall Coping, cheaper and better than stone, Sewer Pipe, Sewer Pipe Specials, etc., etc. Send for Circulars, Catalogue, etc. "The Best is Always the Cheapest."

THE DUN-PERLEY CO., COLUMBUS, OHIO.

Room 13 Hayden Block, 20½ East Broad Street.

THE SOUTHERN GRANITE CO.,

George Moerlein, President.
John Goetz, Jr., Vice-Pres't.
J. A. Eberhardt, Sec'y, Treas. & Gen. Mgr.

General Contractors in **GRANITE.**

QUARRIES AT LITHONIA, REDAN AND ROCKDALE, GA.

Street Paving Work a Specialty.

20 KIMBALL HOUSE BLOCK,
ATLANTA, GA.

OFFICES

19 & 20 WIGGINS' BLOCK,
CINCINNATI, O.

THE BEST PAVING MATERIAL

While Paris, London and Berlin are putting down miles of wood pavement yearly, having proven it the best and most economical, though costing much more there than here, some cities in our own country profiting by their experience are doing the same, as ten miles of our *sapless cylindrical paving blocks* will be laid in Michigan and Indiana during the season of 1891, making an ideal roadway at a low cost. Our second quality blocks make the cheapest crosswalks and warehouse floors and paving for private alleys. Cities desiring the best paving material—dollar for dollar—in the world, should not fail to investigate the merits of our product.

ROSS SAPLESS BLOCK PAVING COMPANY,

SAGINAW, E. S., MICHIGAN.

Cedar Block Pavements

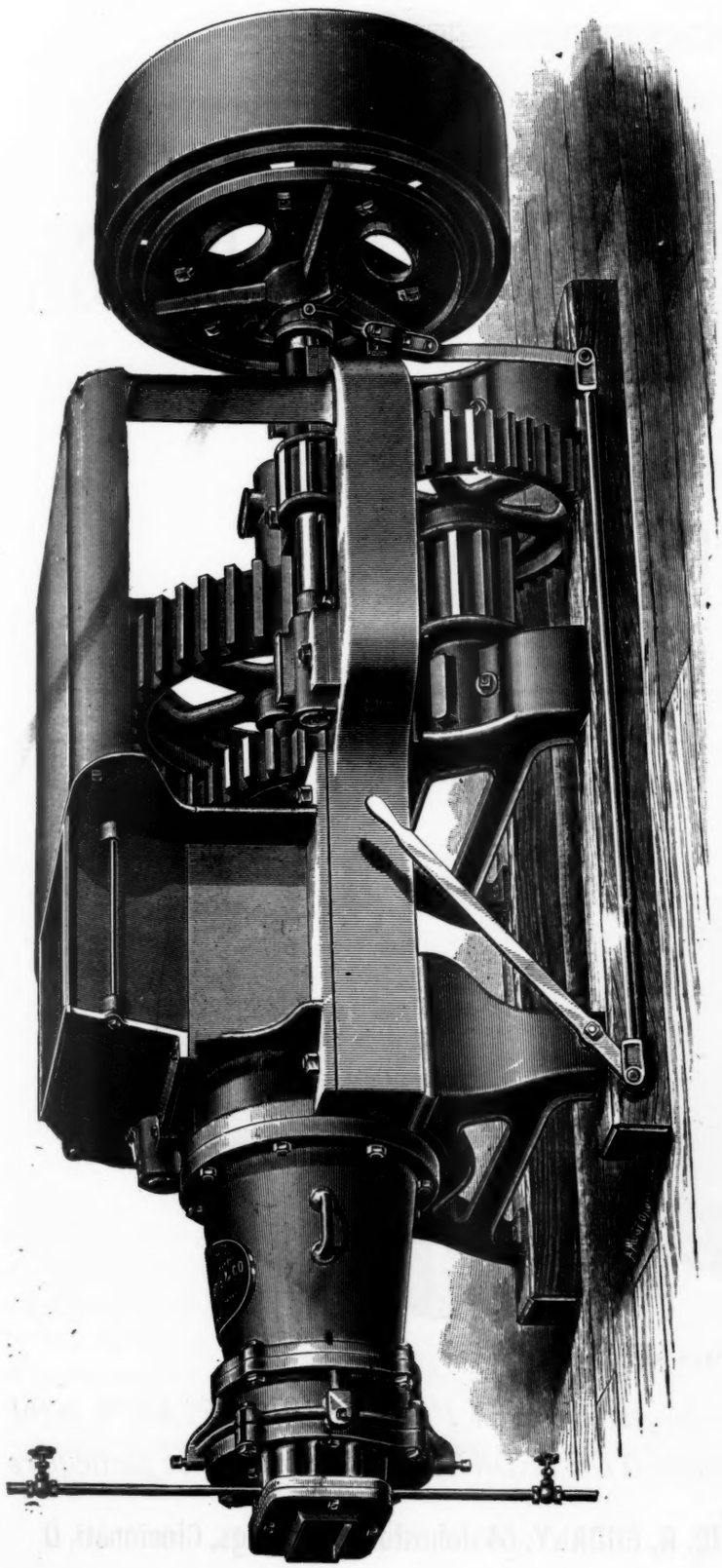
NOISELESS.
DURABLE.
INEXPENSIVE.

LAID IN A SCIENTIFIC MANNER AND GUARANTEED BY

WILLIAM R. JONES, Muskegon, Mich.

Cedar Blocks Furnished in any Quantities.

The New "Ohio" Brick Machine.



THE MACHINE IS WELL MADE.

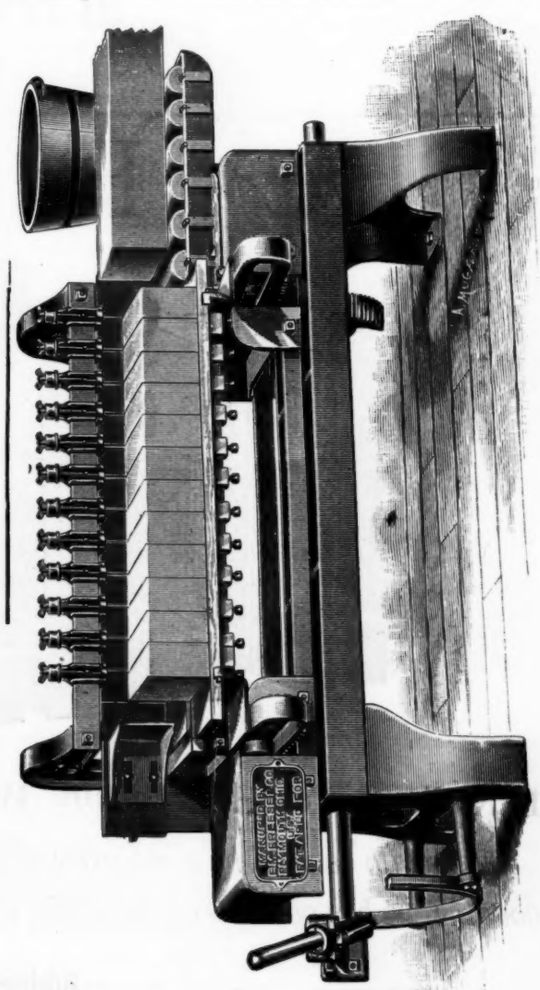
AND IS SUBSTANTIAL AND SERVICEABLE.

IT HAS special advantages not found in others, and will produce brick of the best quality at the lowest cost.

PARTICULARLY WELL
ADAPTED TO THE MANUFACTURE
OF STREET PAVING
BRICK OF THE GREATEST DENSITY.

FOR FURTHER PARTICULARS, ADDRESS

E. M. FREESE & CO., GALION, OHIO.



PENFIELD

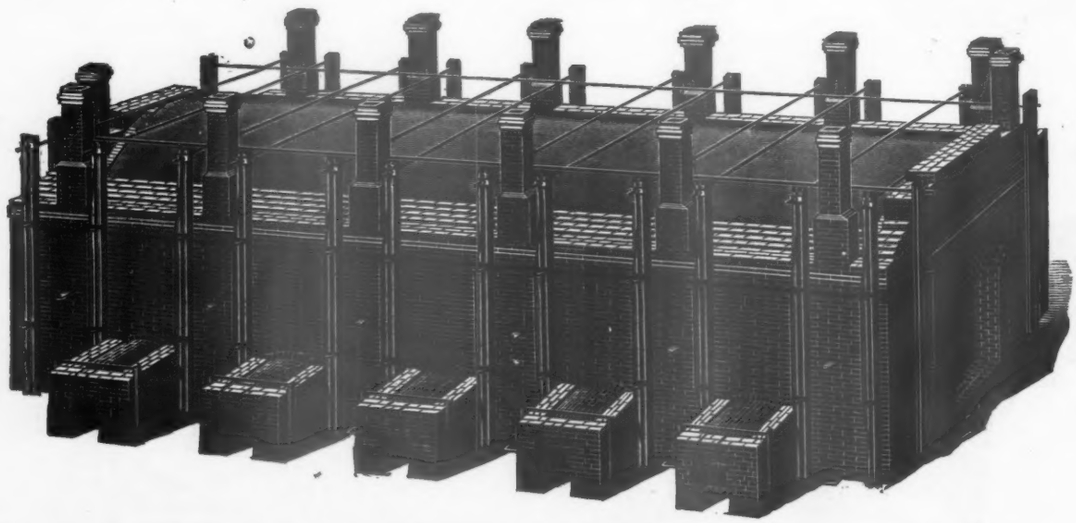
PAVING BRICK MACHINERY

Are you posted on PAVING BRICK? Our free book on Brick Pavements tells all about vitrified brick—how to test—methods of laying—where used and with what success—opinions of City Engineers—selection of clay and machinery.

Our catalogue of brick making and clay working machinery free to interested parties.

Address, J. W. PENFIELD & SON,
Willoughby, Ohio, U. S. A.

The Eudaly Kiln



Is No Longer an Experiment. Burns All Hard

This kiln is used by a majority of the largest STREET PAVING BRICK PLANTS in the country. It has no superior for FINE PRESSED OR FRONT BRICK. For further particulars

Address W. A. EUDALY, 64 Johnston's Buildings, Cincinnati, O.